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L.A. Jobidon, M.L. Parker, P.A. Bramhall, and S.G. Johnson

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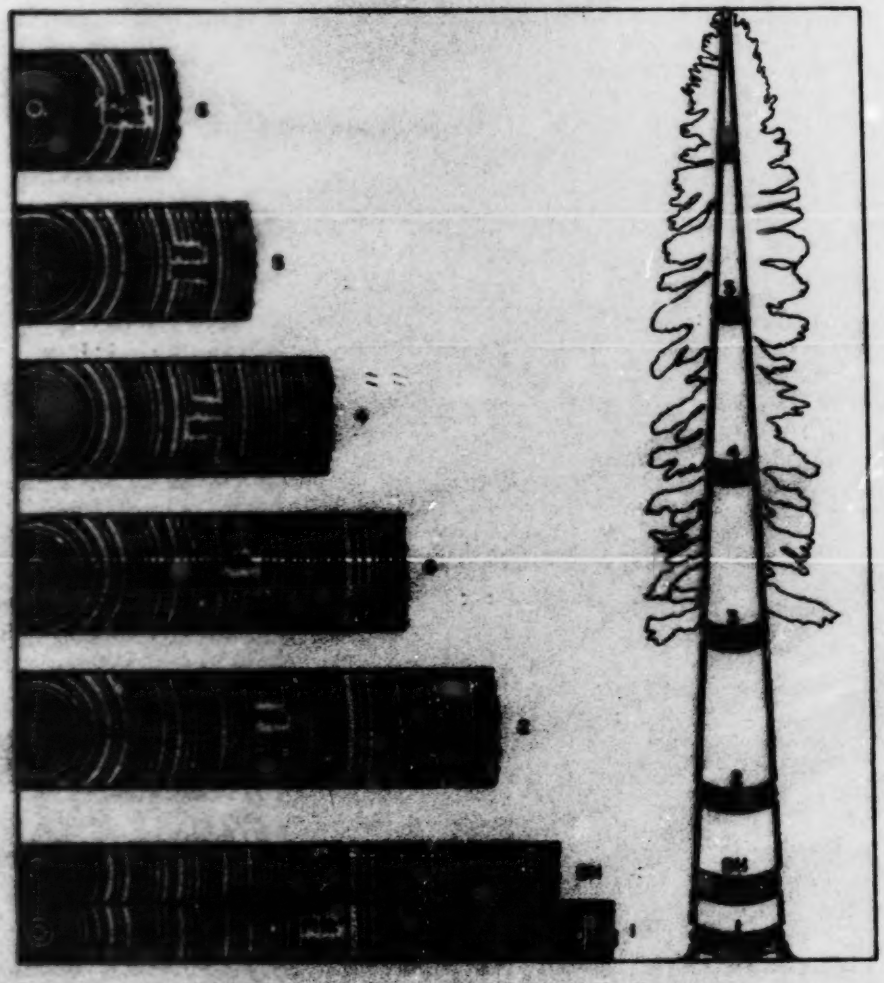

Canada

HOW CLIMATE AFFECTS TREE GROWTH IN THE BOREAL FOREST

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ABSTRACT

Computerized X-ray densitometry techniques were used on tree ring samples collected from white spruce (*Picea glauca* (Moench) Voss) trees in Alberta, Saskatchewan, Manitoba, and the Northwest Territories and black spruce (*Picea mariana* (Mill.) B.S.P.) trees in northern Manitoba. Detailed annual ring-width and ring-density chronologies were produced for samples from eight white spruce and two black spruce sites. Strong climate-tree growth relationships were indicated by numerous common marker years, strong cross-dating between randomly selected individual cores and site summary chronologies, and high correlations between tree-ring chronologies for sites hundreds of kilometres apart.

RESUME

Des techniques informatisées de densitométrie par les rayons X ont été employées pour analyser des échantillons de cernes annuels prélevés sur des épinettes blanches (*Picea glauca* (Moench) Voss) en Alberta, en Saskatchewan, au Manitoba et dans les Territoires du Nord-Ouest, ainsi que sur des épinettes noires (*Picea mariana* (Mill.) B.S.P.) dans le nord du Manitoba. Des suites chronologiques d'après la largeur et la densité des cernes ont été établies pour huit emplacements de l'épinette blanche et deux de l'épinette noire. Des rapports étroits entre le climat et l'accroissement des arbres sont indiqués par de nombreuses années de référence, un degré élevé de synchronisation de carottes choisies au hasard avec des chronologies sommaires des emplacements et des corrélations élevées entre les chronologies établies à partir des cernes pour des emplacements distants de centaines de kilomètres.

FOREWORD

ENFOR is the acronym for the Canadian Government's ENergy from the FORest (ENergie de la FORêt) program of research and development aimed at securing the knowledge and technical competence to facilitate in the medium to long-term a greatly increased contribution from forest biomass to our nation's primary energy production. This program is part of a much larger federal government initiative to promote the development and use of renewable energy as a means of reducing dependence on petroleum and other nonrenewable energy sources.

The Canadian Forestry Service (CFS) administers the ENFOR Biomass Production program component which deals with such forest-oriented subjects as inventory, harvesting technology, silviculture and environmental impacts. (The other component, Biomass Conversion, deals with the technology of converting biomass to energy or fuels, and is administered by the Renewable Energy Branch of the Department of Energy, Mines and Resources). Most Biomass Production projects, although developed by CFS scientists in the light of ENFOR program objectives, are carried out under contract by forestry consultants and research specialists. Comtractors are selected in accordance with science procurement tendering procedures of the Department of Supply and Services. For further information on the ENFOR Biomass Production Program, contact:

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or a CFS research laboratory.

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INTRODUCTION

Increasing interest in using forest products for fuel and food supplements, (especially for animal fodder) demonstrates a need to develop rapid, economical long-term inventories of biomass and project annual biomass yields. The rate of biomass renewal under different conditions is largely unknown. Climate has a direct and pronounced effect on forest vegetation, but little is known about the effect of climate on biomass and how climatic fluctuations affect growth and yield. Development of present-day forests, including growth rates, species composition, longevity, and total biomass, was largely dictated by past climatic conditions. Records indicate, however, that climates have changed. Predictions relating to future forest biomass must therefore consider climatic variation.

Information on climatic fluctuations in the Boreal Forest Region is required. There are, however, few long-term climatological stations in this zone and none has 100-year records. There is some proxy data indicating that significant climatic fluctuations occurred in the recent and distant past and that the position of the Boreal Forest Region and the northern tree line have fluctuated over time. The boreal forest currently occupies a zone with a summer temperature range of only 2°C. Any long-term temperature decrease, therefore, even of 0.5°C, would adversely affect this zone and its biomass productivity. Consequently, information is required in two specific areas: 1) impact of climate on forest biomass production; and 2) past climates in the Boreal Forest Region (Powell 1981).

Climatic change is of particular significance in the northern and southern limits of the boreal forest, or along the periphery of a species range. A good account of climatic significance to forestry is given by Layser (1980). He points out that a one-degree reduction in temperature can reduce the growing season in middle latitudes by two weeks and create severe ice conditions in the arctic. He states that climatic change may significantly affect projected yields and rotation length of forest tree species.

Long-term trends also are important. For example, Rowe (1967) reports a northward migrating rate of 150 m (500 feet) a year for the boreal forest in Canada. As well, short-term fluctuations over periods of decades occur and have biological and socio-economic effects that are important to foresters and land managers.

Some data analysis was undertaken in this study, but the main purpose was to provide detailed annual ring-width and ring-density data for many trees from an extensive portion of the boreal forest. This information (in raw data form and in summary tree-ring chronology form) is stored on magnetic tape and is available for future climate and tree growth studies.

FIELD COLLECTION AND SITE LOCATIONS

Of the eight forest regions described by Rowe (1972), the Boreal Forest Region represents the largest forested area in Canada. It forms a continuous belt from the east coast to the Rocky Mountains and northwestward to Alaska. Rowe divided the Boreal Forest Region into three zones:

- Predominantly forest;
- Forest and Grassland (transition to the prairies); and
- Forest and Barren.

The zones extend from the Prairies in the south to tundra in the north. Rowe makes further classifi-

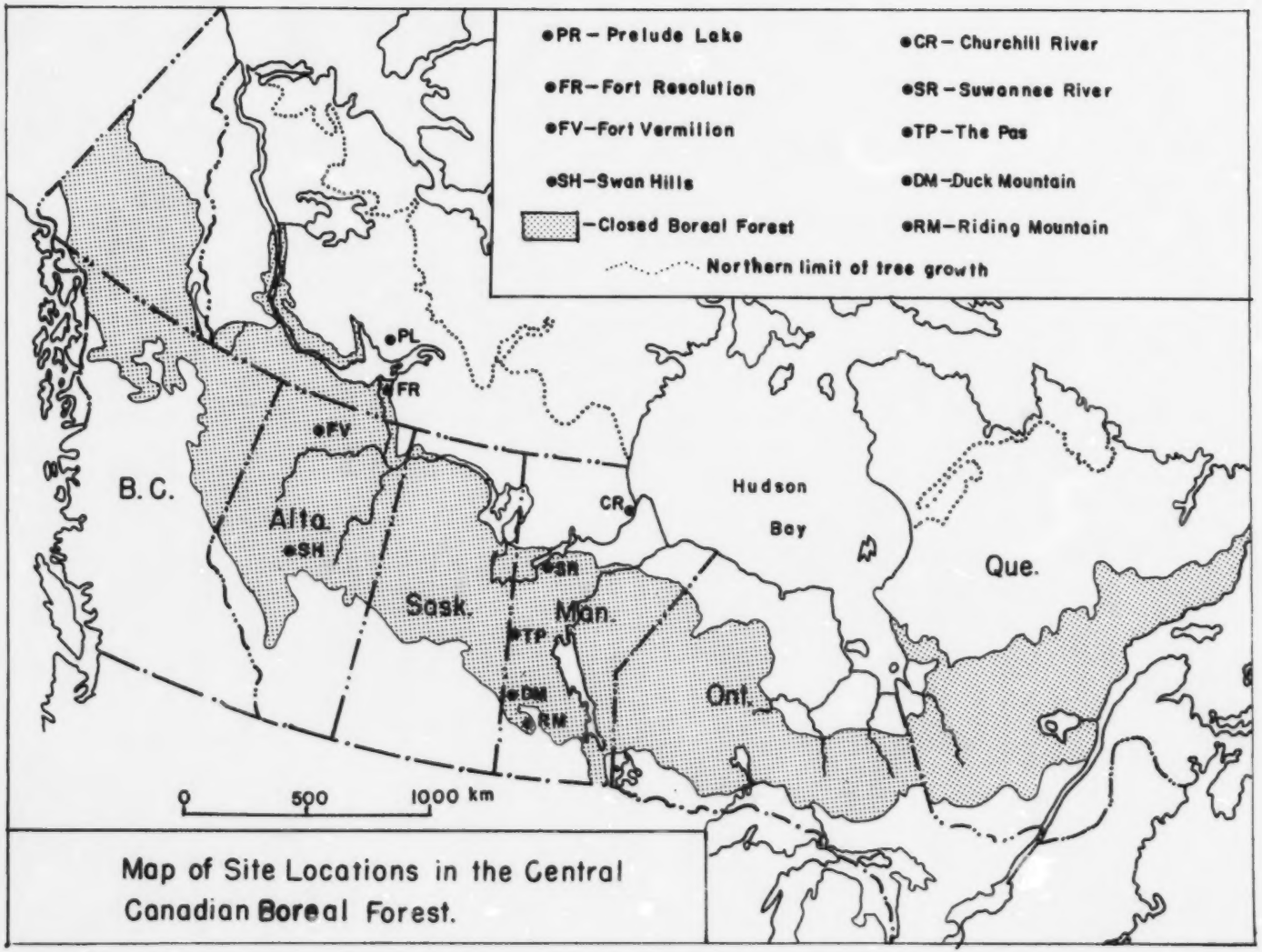

Figure 1. Tree-ring sampling sites within the boreal forest.

cations and subdivisions, resulting in 90 forestland units across Canada called Forest Sections.

Two transects of sites through the boreal forest were set up using white spruce and black spruce as sample species. One transect (the Alta.-NWT Transect) extends from near the southern limit of the Boreal Forest Region in Alberta to near the northern limit of the boreal forest in the Northwest Territories. The other transect (Manitoba Transect) extends from near the southern limit to near the northern limit of the boreal forest in Manitoba.

Table 1 lists sampling sites, location, forest section according to Rowe, collection date and type, species and stand age, (from south to north) for the Alta.-NWT and Manitoba transects. It also indicates samples that were analyzed by X-ray densitometry. Figure 1 is a map showing tree-ring sampling sites within the boreal forest.

Work on this contract has been done with the Northern Forest Research Centre, Canadian Forestry Service (CFS), under the supervision of J.M. Powell. Most field collections were done by L.A. Jozsa of Forintek Canada Corp. and N.B. Schultz, Northern Forest Research Centre, with some assistance from J.M. Powell and M.L. Parker.

Fifteen trees were sampled at each site. Two cores were taken from each tree to study the effect of climatic variability on tree growth. For estimating forest biomass production, four of the 15 trees were felled, delimbed, measured, and sectioned. Seven cross-sectional disks were cut from each tree: one at the base, one at breast height (1.3 m), and five at one-sixth-total-height intervals.

White spruce [*Picea glauca* (Moench) Voss] was chosen because it has a wide distribution range, its growth is responsive to variations in climate, and it is relatively free from insects and disease. A minimum stand age of 200 years was sought because older trees are more sensitive to variations in climate and longer chronologies provide better tree-ring data for studying past climates.

Availability of white spruce became a problem north of the 56° parallel in Manitoba (contrary to technical information in the literature). For this reason black spruce [*Picea mariana* (Mill.) B.S.P.] was chosen for the northern sites in Manitoba for studying biomass production along the entire transect. Because black spruce had not been used extensively in previous dendrochronological studies, the tree-ring quality of black spruce was examined and compared with white spruce under identical site conditions.

METHOD OF ANALYSIS

Dendroclimatological techniques and methodologies have been well established in western Canada (Parker 1970, 1976; Parker and Jozsa 1973, 1977; Parker and Kennedy 1973; Parker *et al.* 1973; Parker *et al.* 1977, 1980). It has been recently shown that on an altitudinal transect in the Columbia River valley of southeastern British Columbia, temperature/tree ring correlations were more significant at higher elevations and precipitation/tree ring correlations more significant at lower elevations (Western Forest Products Laboratory 1979). A similar relationship may occur on a latitudinal transect encompassing the Boreal Forest Region. If this relationship can be shown, it will have relevance for any dendroclimatological studies undertaken in the interior plains area and elsewhere in North America.

Table 1. Details of tree sampling

Locations	Coordinates latitude (N)	Coordinates longitude (W)	Forest section	Collection date	White spruce	Black spruce	Stand age (yrs)	Increment cores	4 trees felled and sectioned	Analyzed by X-ray densitometry
Alberta-Northwest Territories Transect										
Cypress Hills	49°38'	110°10'	Lower Foothills	Sept. 20, 1979	X		120	X		
Sundre	51°39'	115°28'	Upper Foothills	Aug. 25, 1980	X		190	X	X	
Hinton	53°35'	117°40'	Subalpine Forest Region	Aug. 27, 1980 (felled Jul. 1980)	X		250	X		
Swan Hills	54°50'	115°40'	Lower Foothills	Sept. 14, 1979	X		275	X	X	X
Imperial Mills	54°59'	111°45'	Mixedwood	Sept. 13, 1979	X		120	X	X	
Fort Vermilion	58°31'	116°25'22"	Hay River	Sept. 15, 1980	X		180	X	X	X
Sweetgrass	58°52'	111°59'	Upper Mackenzie	Sept. 9, 1980	X		180	X	X	
Cameron Hills	60°20'	117°20'	Hay River	Sept. 13, 1980 (felled Feb. 1980)	X		150	X		
Fort Resolution	61°18'	113°	Upper Mackenzie	March 17, 1980	X		200	X		X
Prelude Lake	62°32'50"	113°55'12"	Northwestern Transition	Sept. 11-12, 1980	X		200	X	X	X
Coppermine	67°30'	115°30'	Forest-Tundra	July, 1979	X		500	X		(X)
Manitoba Transect										
Riding Mountain	50°44'46"	99°59'30"	Mixedwood	Sept. 19, 1981	X		111	X	X	X
Duck Mountain	51°34'30"	101°03'40"	Mixedwood	Sept. 20, 1981	X		165	X	X	X
Kelsey Trail (Sask.)	53°27'	102°40'	Manitoba Lowlands	June 19, 1981 July 20-21, 1981	X		200	X	X	
The Pas	54°05'42"	101°22'20"	Manitoba lowlands	Sept. 16-21, 1981	X		117	X	X	X
Suwannee River	56°06'20"	99°54'00"	Northern Coniferous	Sept. 24, 1981	X	X	111 122	X	X	XX
Lynn Lake	57°05'12"	101°27'00"	Northwestern Transition	Sept. 23, 1981		X	90	X	X	
Churchill River	58°20'	94°43'	Hudson Bay Lowlands	Aug. 17, 1981		X	90	X		(X)

(X) Tree-ring data from these sites were available and were used in comparisons with the Biomass sites.

X-Ray Densitometry

Ring-width and ring-density data were derived for this study by using X-ray densitometry. This method was pioneered in France by Hubert Polge (1963, 1966). X-ray densitometry techniques and instruments used at Forintek Canada Corp. are described in detail elsewhere, (Parker *et al.* 1980), but they are briefly as follows:

(1) increment cores are air-dried, then glued between two mounting sticks;
(2) mounted cores are cut to uniform thickness on a twin-blade saw designed for this purpose (Kusec 1972);
(3) samples are labeled with X-ray opaque paint;
(4) a portion of one core mounting stick is cut away and the cell angle (the angle formed by the long axis of longitudinal tracheid cells and the long axis of the increment core) is measured under a microscope;
(5) prepared cores are placed on X-ray film with calibration wedges, then exposed at the proper angle by a moving X-ray machine;
(6) X-ray film is carefully developed;
(7) the radiograph is examined on a light table under a low-power microscope, and calendar-year dates and other information are marked on it;
(8) radiographs are scanned on a computerized densitometer that converts increment core images into ring-width and ring-density data; and
(9) data are stored on magnetic tapes for further processing and summarizing.

Deriving the Chronology Types

Raw data used for each site consisted of ring-width values in 0.01-mm units and maximum ring-density values in g/cm^3 measured at 0.01-mm increments along the core's scanned portion. In some cases ring volume and ring weight (for 1-cm-thick disks) were also used. Raw data are standardized by conversion to indexes (ratio of observed value to fitted trend, yielding values with a mean of 1.00) by removing the growth trend (and sometimes other trends or fluctuations). Standardized data (indexes) for all cores are then summarized, or averaged, to produce a summary or master chronology for the site.

The procedure for deriving different types of chronologies is demonstrated in Figure 2, using an individual core from a white spruce tree from the Swan Hills sampling site in Alberta. The different chronology components are as follows:

(1) Raw Data, produced by measuring and noting width (or density) of annual rings for each year of the tree's life. In Figure 2, raw ring-width data are shown in a broken-line plot form;

(2) The A component, the biological growth trend of the tree from pith to bark, shown superimposed over the raw data broken-line plot. The A component was determined mathematically by a 99-year-long digital filter and is often referred to as the growth trend or weighted running mean;

(3) The B & C component, best known as tree ring indexes, used traditionally in climatic comparisons and past climate reconstructions. The B & C chronology is produced by removing the A component from the raw data. This is accomplished by calculating individual data points or the ratio between raw data values and their A trend-line values.

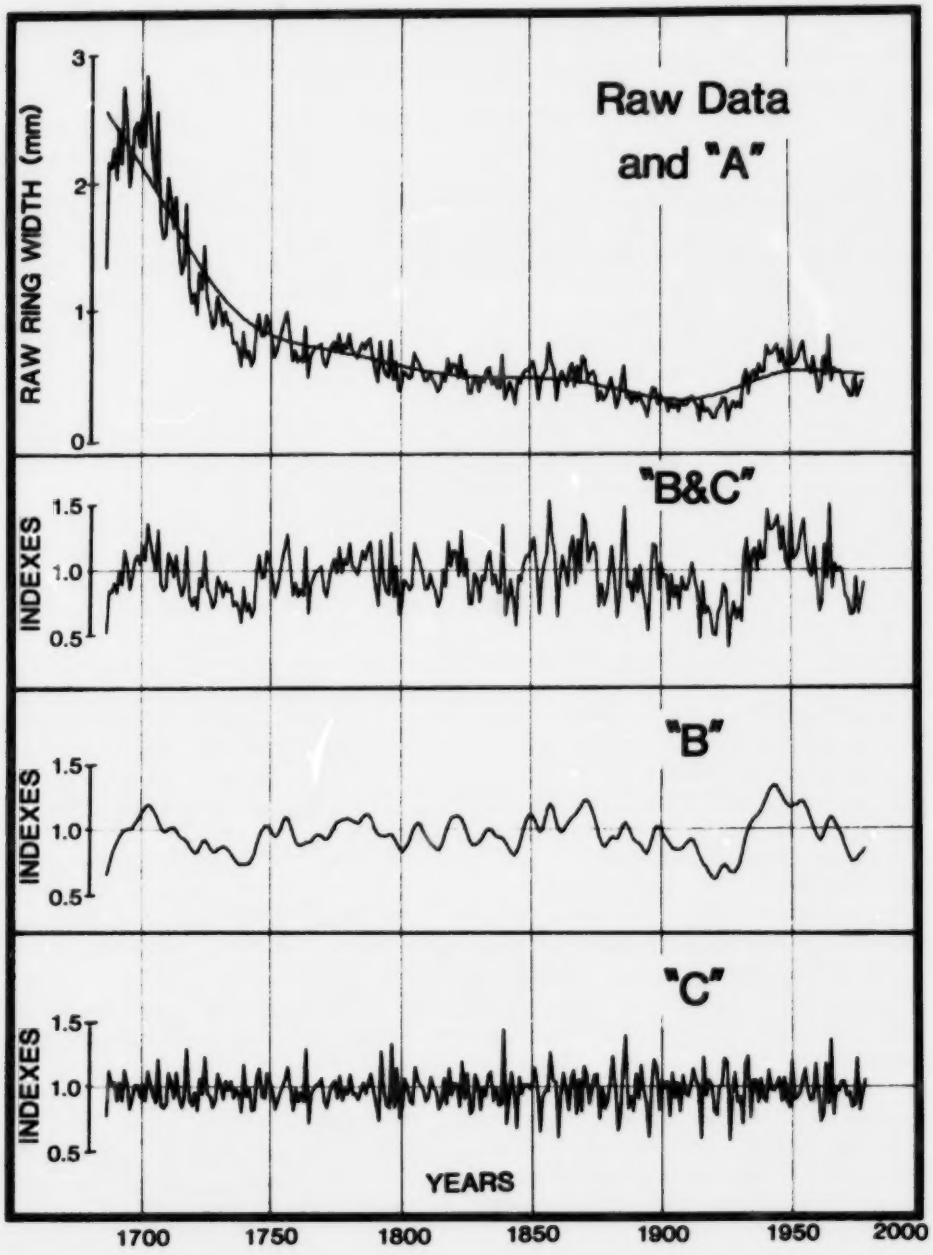

Figure 2. Components of a ring-width data series of a white spruce increment core from the Swan Hills, Alberta, tree-ring site. The growth trend or A component is superimposed on the broken-line plot of the raw ring-width data. The B & C component is the chronology that remains after the A component has been removed. Short-term fluctuations are represented by the B component and the C component consists of the year-to-year fluctuations.

(4) The B component, which is a weighted running mean of the B & C chronology and is calculated by a 13-year digital filter. This line shows short-term fluctuations, greater than 13 years in length and shorter than 99 years; and

(5) The C index values, determined as the ratio between B & C individual values and their B trend-line values. The 13-year digital filter removes the climatic trends (and sometimes other trends or fluctuations) greater than 13 years and results in the C chronology. This form of data has proven to be most useful for dating and studying climate on a year-to-year basis.

If increment core data are averaged without removing the growth trend, nonclimatic fluctuations related to age of the tree will be included in the chronology. It is therefore essential that growth trend be removed. Variation due to climate may be removed inadvertently, however, if proper techniques are not used in this procedure.

Summary chronologies are obtained from ring-width and maximum ring-density data (and ring volume and ring weight for some sites) by removing the growth trend. Values for all cores selected for processing from each site are then averaged into one composite ring series by calendar dates for each parameter (ring width, maximum ring density, ring volume, and ring weight) and for each component (A, B, C, and B & C). The A, B & C, and C chronologies have been used in this study.

The A component chronologies are constructed by averaging estimated curve values of all increment cores. These chronologies are averaged by age from pith rather than by calendar-year dates of the rings to produce a single series, which is an average of all growth trends of all cores. These trend lines are determined mathematically.

Cross-dating Matrix Method

To get information about north-south and east-west correspondence between tree-ring series, and by inference, climate-tree relationships, a cross-correlation comparison was made of all combinations between selected chronologies from 10 tree-ring sites. The sites used were:

A. Alta.-NWT Transect (south to north)
   1. Swan Hills White Spruce;
   2. Fort Vermilion White Spruce;
   3. Fort Resolution White Spruce; and
   4. Prelude Lake White Spruce;

B. Manitoba Transect (south to north)
   1. Riding Mountain White Spruce;
   2. Duck Mountain White Spruce;
   3. The Pas White Spruce;
   4. Suwannee River White Spruce;
   5. Suwannee River Black Spruce; and
   6. Churchill River Black Spruce.[1]

Site summary chronologies were used and consisted of ring width (RW) and maximum ring density (MXD). The B & C and C components were used for all sites except Churchill River, where only the C component was used in the cross-dating comparison (Appendices 1 and 2).

Climatic Comparison Method

To determine the month-to-month response of tree-ring variables (ring width, maximum ring density, ring volume, and ring weight) to climatic factors (temperature and precipitation), cross-correlation comparisons were

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1. The Churchill River tree-ring material was collected by M.L. Parker in 1981 and processed at Forintek Canada Corp. on Project 32, Dendroclimatic Investigations in Canada, under a contract with the CFS.

made among these variables. The climatological data used were mean monthly temperature and total precipitation from May to September for as many years as data were available from climatological stations near the tree-ring sites listed in Table 2. Monthly climate data were supplied by the central and western region offices of the Atmospheric Environment Service, Environment Canada, in Winnipeg and Edmonton.

Most climatic stations in Canada, particularly those with long records, are valley-floor sites or are located near communities with a long history of continuous habitation. Such communities are rare near our sampling sites. As well, some of the climate stations are missing considerable data, especially from the first three to four decades of this century. For example, the Swan River station in Manitoba has a 73-year instrumental record (1908-1980). Unfortunately, there are so many statistics missing prior to 1944 that only 45 years of records could be used in the correlation analysis.

The C chronologies of ring width and maximum ring density were used in comparisons for four sites on each north-south transect. The B & C chronologies were used for four sites on the Manitoba Transect. These correlations are presented in bar graph form in the results and discussion section.

RESULTS AND DISCUSSION

Growth Characteristics

Width, Density, and Weight Age Trends

It was expected there would be a clear-cut pattern, or continuum, of growth trends with age in the chronologies progressing from south to north. In Figure 3, the growth trend curve is flatter for northern sites, but this is not a marked or consistent characteristic. Figure 3 presents age trends (A chronologies) for ring width for the Alta.-NWT Transect. For five Manitoba tree-ring sites, age trends for ring width (RW), ring density (RD), and ring weight (RWT) are shown in Figure 4. These trend lines were determined mathematically, using a 60-year-long digital filter for all increment cores at each sampling site, and summarized by age, resulting in common pith dates.

Ring width trend lines are relatively flat (little change in RW from pith to bark) except for the Riding Mountain line (line 1). At this most southerly site, average ring width drops dramatically from approximately 3.4 mm near the pith to 1.5 mm at 50 years of stand age. For the next 70 years, from ages 50 to 120, the average RW drops from approximately 1.5 to 0.9 mm. The Duck Mountain (line 2) and the Suwannee River (line 4) RW trend lines are remarkably similar, considering that these two tree-ring sites are 550 km apart on the north-south transect. This similarity may be fortuitous. The difference in latitude could be compensated by elevational difference between the two sites (Duck Mountain is 700 m above sea level (ASL) and Suwannee River is about 265 m ASL). It was shown previously that changes in environmental conditions between two different elevations at a common latitude are analagous to changes between two different latitudes at a common elevation. For example, the Arizona-Senora Desert Museum Newsletter (No. 20, Winter 1978) describes in the article, "One Hour to Canada," a 50-km drive to the top of Mount Lemmon, which is essentially the same environmental experience as driving to the Canadian border from Tuscon, Arizona.

Only The Pas site (trend line 3) shows a positive trend (tree rings becoming gradually wider with age) in

Table 2. List of tree-ring sites, adjacent climatological stations, station locations, and periods of climate record

Tree-ring sites	Climatological station name	Station coordinates latitude (N)	Station coordinates longitude (W)	Periods of climate record
Alberta-Northwest Territories Transect				
Swan Hills	Whitecourt, Alta.	54°08'	115°40'	1943 - 1978
	Wagner, Alta.	55°21'	114°59'	1944 - 1971
	High Prairie, Alta.	55°26'	116°30'	1927 - 1976
Fort Vermilion	Fort Vermilion, Alta.	58° 23'	116°02'	1908 - 1979
Fort Resolution	Fort Resolution, NWT	61°10'	113°40'	1912 - 1979
Prelude Lake	Yellowknife, NWT	62°28'	114°27'	1942 - 1979
Manitoba Transect				
Riding Mountain	Dauphin	51°09'	100°02'	1911 - 1976
	Dauphin A.	51°06'	100°03'	1942 - 1980
	Wasagaming	50°39'	99°58'	1966 - 1980
Beautiful Lake	Pine River	51°46'	100°19'	1970 - 1980
Duck Mountain	Swan River	52°06'	101°16'	1908 - 1980[1]
Root Lake (near The Pas)	Wanless	54°11'	101°22'	1936 - 1979
	The Pas A.	53°58'	101°06'	1943 - 1980
	The Pas	53°49'	101°15'	1910 - 1969
Suwannee River	Laurie River Power Site	56°14'	100°59'	1960 - 1970
	Pickerel Narrows	56°13'	100°35'	1963 - 1977
	Thompson A.	55°48'	97°52'	1967 - 1980

[1]Data are missing for many years prior to 1944.

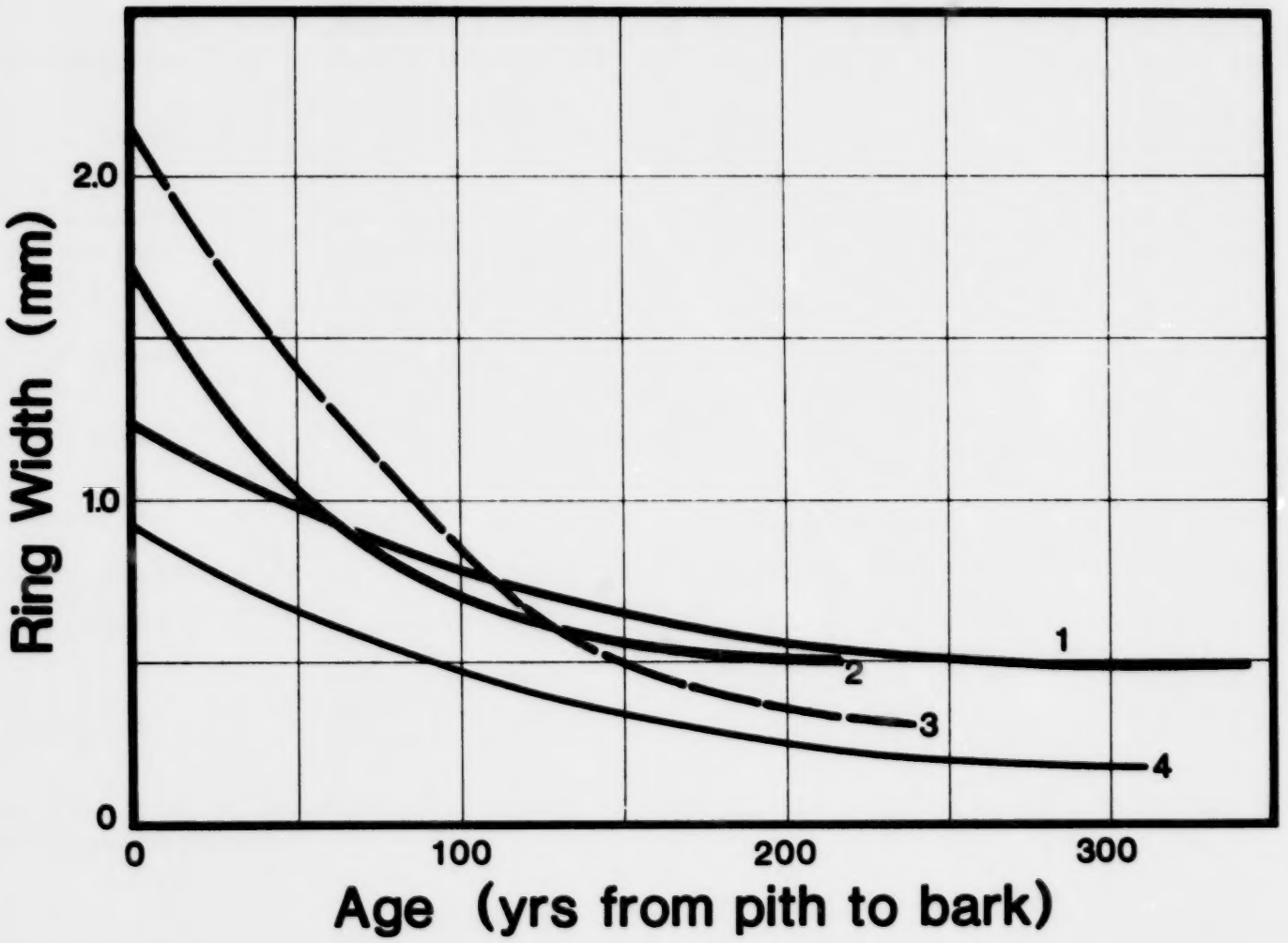

Figure 3. Ring width age trends for the Alberta-NWT Transect sites; Swan Hills (1), Fort Vermilion (2), Fort Resolution (3), and Prelude Lake (4).

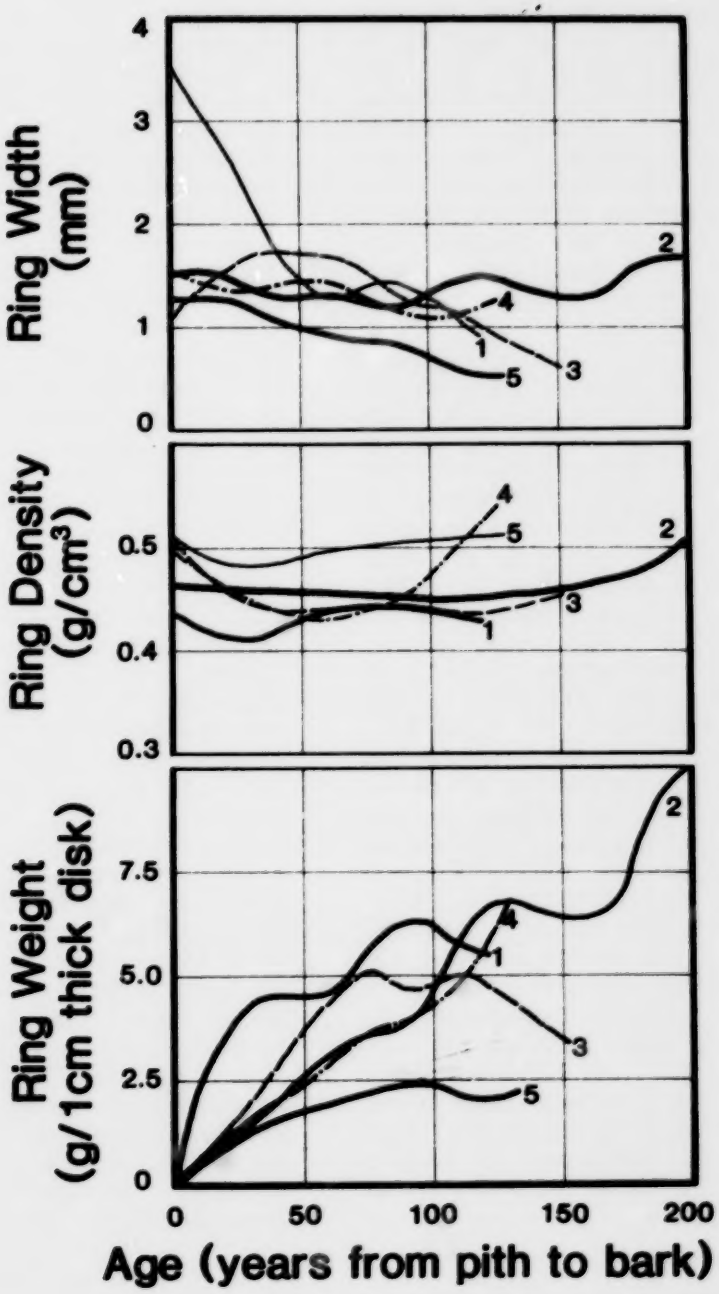

Figure 4. Ring width, ring density and ring weight age trends for the Manitoba Transect sites; Riding Mountain (1), Duck Mountain (2), The Pas (3), Suwannee River white spruce (4) and black spruce (5).

the juvenile wood zone. From the pith (0) to approximately 30 years of age, average ring width increases from about 1 mm to 1.75 mm. The trend line then drops from 1.75 mm at age 50 to approximately 0.6 mm at age 160. This initial suppression and the following release occurred because trembling aspen was a pioneer cover that established itself first at this site. White spruce, because of its tolerance to shade, was a secondary species. The other three white spruce sites were essentially pure evergreen stands throughout their history.

Relatively narrow tree rings of black spruce at the Suwannee River site (line 5) show a linear trend from 1.2 mm at the pith (0 yr.) to 0.5 mm average RW at the bark (130 yr.). Age trends for ring density (RD)[2] are also shown in Figure 4. Interestingly, only the most southerly white spruce site at Riding Mountain and the black spruce site at Suwannee River show low density juvenile wood zones at age 30, but core wood near the pith was always more dense at all five sites. The higher ring density could result from mechanical stimulations of wind action at breast height (1.4 m) on the sapling leaders, yielding reaction wood formation (Kellogg and Steucek 1980). The RD trend lines corresponding to white spruce sites at The Pas and Suwannee River (lines 3 and 4, respectively) are identical from pith to about age 40, a 15% decrease from approximately 0.50 to 0.43 g/cm^3. For The Pas, RD was relatively uniform from 40 to 160 years of age. For the Suwannee River white spruce, however, a dramatic 26% increase in RD increment is evident from about ages 70 to 160 years (from 0.43 to 0.54 g/cm^3).

Ring density, although difficult to measure year-to-year by conventional methods, is an important parameter of wood quality. It is strongly correlated with both strength of wood and pulp yields. Also, density determination is essential in evaluating biomass production. Total biomass for an individual tree ring can be defined as total weight of the solid wood substance contained in that annual increment. Ring weight (RWT) age trends are shown for a 1-cm thick average breast height disk for each site in Figure 4. The five trend lines show graphically yearly weight productivity of different sites on the Manitoba Transect. The least productive species/site combination is the Suwannee River black spruce, line 5. Riding Mountain (trend line 1) is the most southerly and the most productive of the tree-ring sites. Except for Duck Mountain (line 2), a good ranking is evident, especially for the first 100 years, from the most productive site (south) to the least productive site (north). Again, as evidenced by ring-width trend lines, Duck Mountain and Suwannee River white spruce ring-weight trend lines (2 and 4) are almost identical.

Volume and weight of entire annual increments can be obtained by processing data for the four intensively sampled trees at each site. The volume of an entire annual increment depends on its distance from the pith at the base of the stem, its ring width, its taper, and its distance up the stem to the tip of the leader for that year's growth. These tree-ring statistics are available for four intensively sampled trees at each site. Figure 5 illustrates the information collected for a tree sampled at Suwannee River. Also shown are tree-

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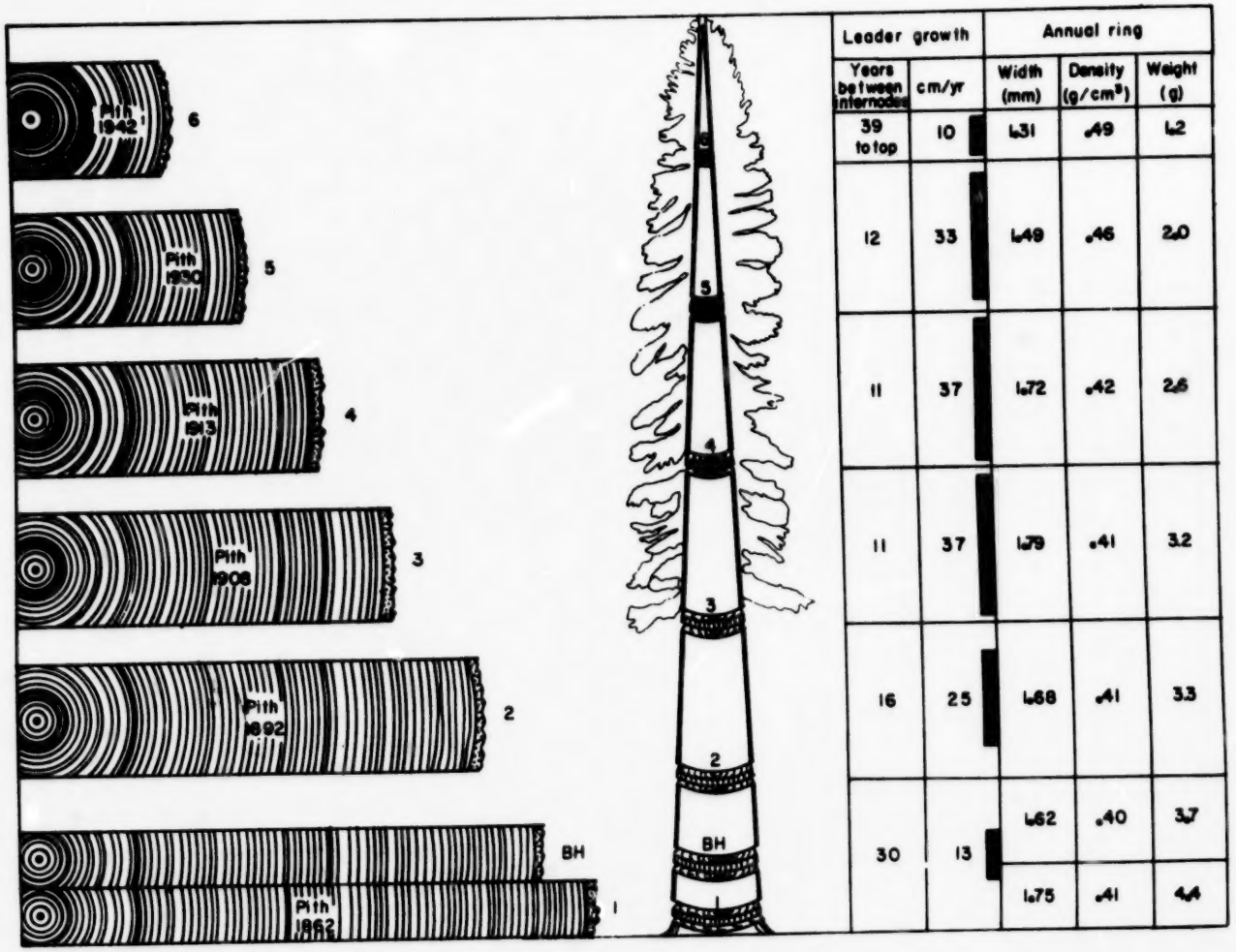
2. All density values are expressed on an ovendry volume and weight basis. The quoted numbers are, therefore, about 10% higher at the 0.45 level than the conventional basic wood density, which is always expressed on a green volume and ovendry weight basis.



Leader growth		Annual ring		
Years between internodes	cm/yr	Width (mm)	Density (g/cm³)	Weight (g)
39 to top	10	1.31	.49	1.2
12	33	1.49	.46	2.0
11	37	1.72	.42	2.6
11	37	1.79	.41	3.2
16	25	1.68	.41	3.3
30	13	1.62	.40	3.7
		1.75	.41	4.4

Figure 5. Seven multiple cross sections from an intensively sampled white spruce tree at Suwannee River, Manitoba. Tree-ring statistics (RW, RD, and RWT) and tree statistics (average leader growth per year in different internodes) are also shown. They are necessary for computing whole annual tree-ring weight increments.

ring statistics necessary in calculating annual ring weight production in the stem. It is interesting to note the average leader growth for the six 4-m-long internodes of this tree, which from the base to the top were 13, 25, 37, 33, 33, and 10 cm per year. Average ring density was similar in the bottom half of the stem: 0.41, 0.40, 0.41, 0.41, and 0.42 g/cm^3 for sections 1, breast height (BH), 2, 3, and 4, respectively. For sections 5 and 6 the average ring density was about 12 and 20% higher at 0.46 and 0.49 g/cm^3, respectively, than for the lower half of the stem.

The higher average ring densities result from higher percentages of latewood and densities of earlywood in sections 5 and 6, which were 15-30% higher than corresponding values for the lower portion of the stem. Density differences are shown by intraring density profiles in Figure 6. It would be interesting to compare breast height disks from other trees and other sites with whole tree statistics because most cruising and stand appraisal work is based on breast height data.

Stand Age, Height, Diameter, and Ring Weight Trends

Tree-ring parameters measured by X-ray densitometry were described above as a function of age. Tree statistics required for calculation of whole increment volumes and weights were mentioned.

This section describes tree diameter and height size trends (based on field measurements), average stand ages, and ring weights (determined in the laboratory) for each site on the two transects. Figure 7 shows these variables for the Alta.-NWT and Manitoba transects. Each tree-ring site was plotted as a function of latitude (degree N). For the two transects the tree heights average about 21-22 m. A south-to-north decreasing trend is evident for the Alta.-NWT Transect (tree heights were not obtained for the Fort Resolution site because these tree-ring samples were collected in a sawmill log yard). For the Manitoba Transect, (four white spruce sites, illustrated by open symbols in Figure 7), tree heights varied from 21 to 25 m with no apparent trend.

The average stand age of white spruce sites on the Alta.-NWT Transect is almost twice that of the Manitoba Transect sites (212 years compared with 126 years). Further comparison of tree diameter at breast height reveals that average trees at the Manitoba sites are about 18% larger (40 cm) than trees at the Alta.-NWT sites (34 cm), despite the latter being 70% older. Trees at the Manitoba Transect sites are better producers of biomass, producing 4 g of wood per year for 1 cm of tree length at breast height compared to 2 g of wood per year at Alta.-NWT sites.

Biomass productivity of different sites on the two transects may be affected by stand age. For example, in Figure 4, the ring weight trend-line 2 (for Duck Mountain) shows a steady increase as a function of age. Simply put, at an older age the stand of trees had a longer time to grow to a larger size. Average ring weight will increase with age and will be greater than at a younger stand age. For this reason, stand ages were standardized at 100 years for each site by calculating average ring weight and average diameter values for 1-cm-thick breast height disks for the first 100 annual increments from the pith (Figure 8). The same pattern emerged as in Figure 7. At 100 years of age the Manitoba Transect white spruce averaged 30 cm dbh and 2.8 g ring weight, compared with 20 cm dbh and 1.2 g for the Alta.-NWT Transect.

The process of standardizing on 100 years least affected the data from Riding Mountain, The Pas, and Suwan-

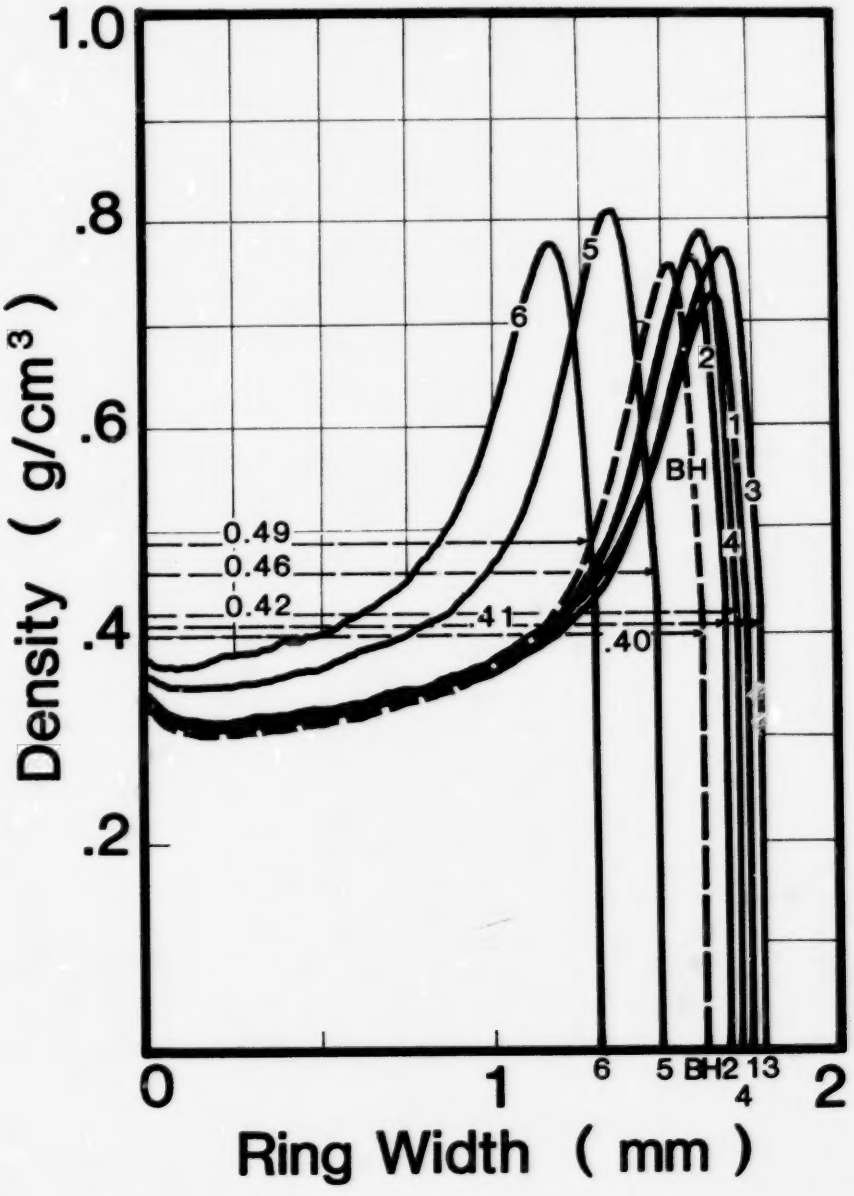


Figure 6. Intraring density profiles (with actual ring-width scale) for the seven cross sections from an intensively sampled white spruce tree at Suwannee River, Manitoba. This tree is illustrated in Figure 5 also, showing number and letter coding.

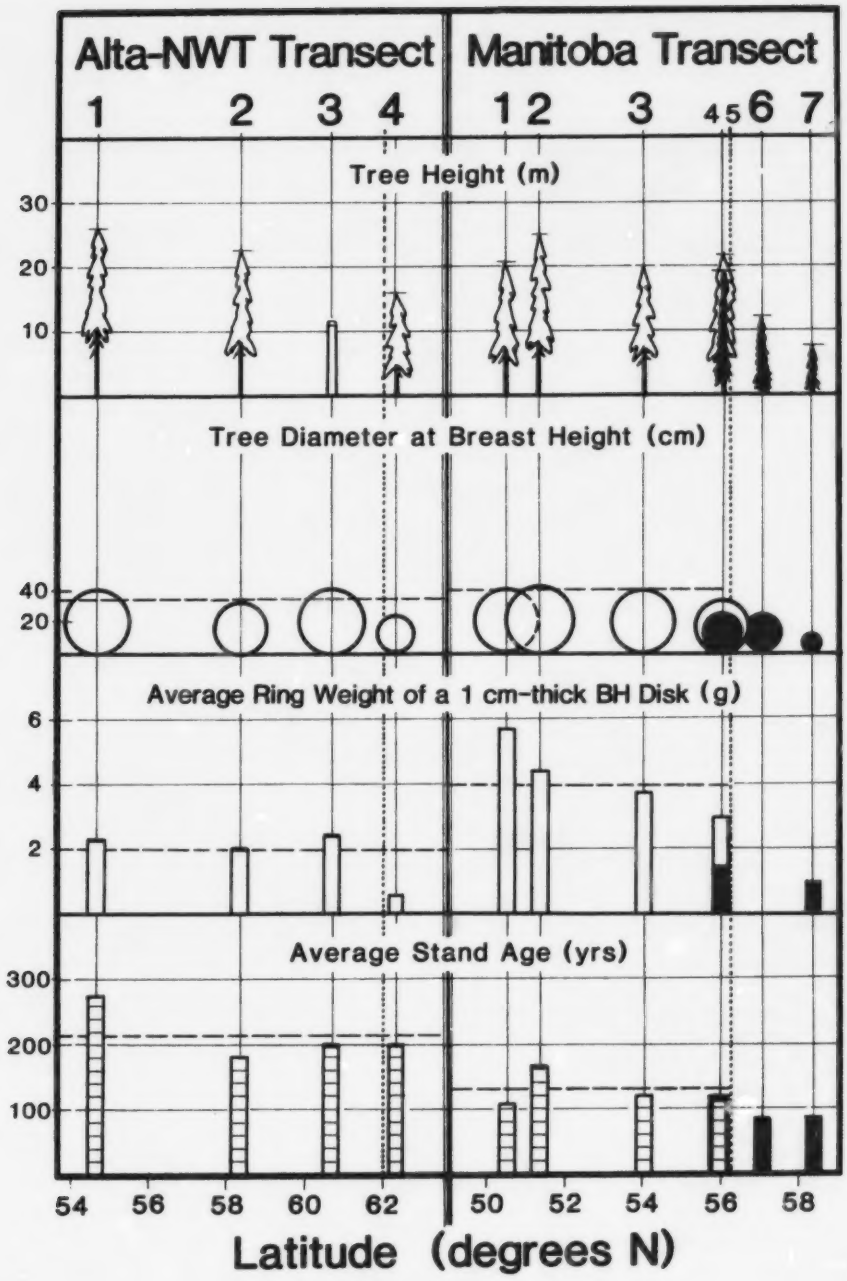


Figure 7. Tree height, tree diameter at breast height, average ring weight of a 1-cm-thick breast height disk, and average stand age trends for eight white spruce sites (open symbols) and three black spruce sites (black symbols). Alta.-NWT Transect sites, from south to north: Swan Hills (1), Fort Vermilion (2), Fort Resolution (3), and Prelude lake (4). Manitoba Transect sites, from south to north: Riding Mountain (1), Duck Mountain (2), The Pas (3), Suwannee River white spruce (4), black spruce (5), Lynn Lake (6), and Churchill River (7). Note the two vertical dotted lines indicating the transition from the closed boreal forest to the open subarctic forest cover, about a 650-km shift for the two transects.

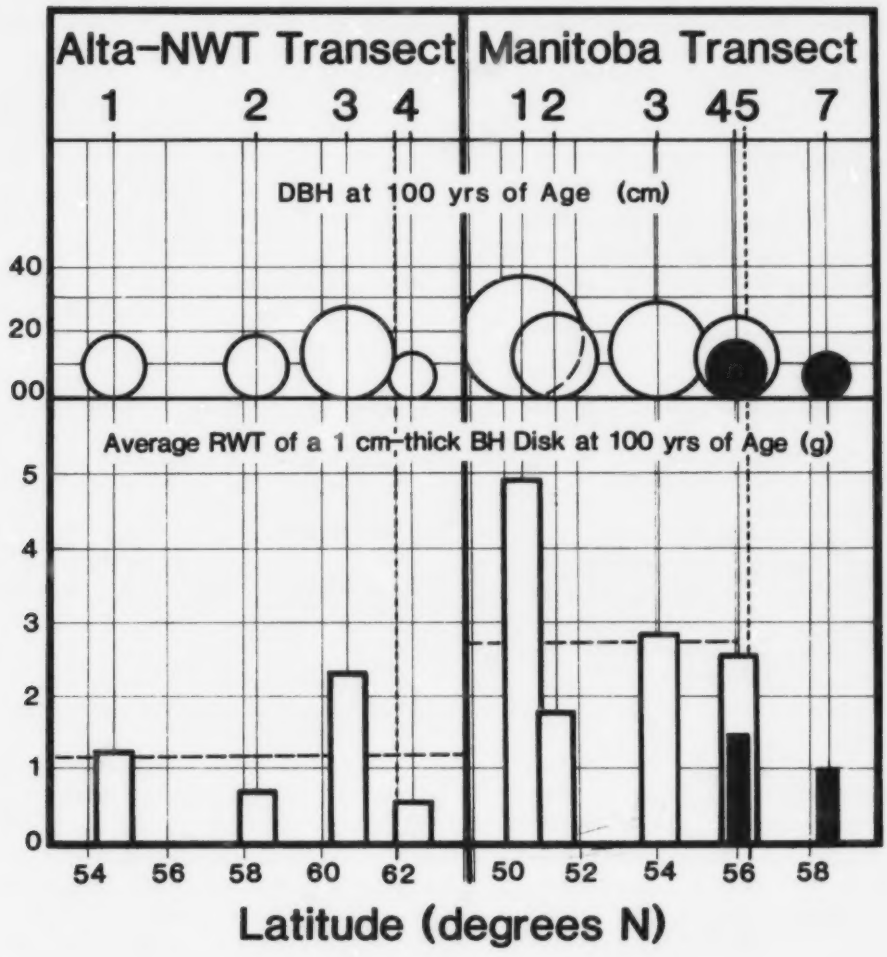


Figure 8. Average diameter at breast height and average ring weight of a 1-cm-thick breast height disk at a standardized 100 years of age for the two transects. See caption of Figure 7 for the explanation of site names and symbols.

nee River because the average age of the stands was very close to 100 years. Data from the Fort Resolution site were virtually unchanged from 2.31 g (for the full period of 1743 to 1979) to 2.29 g for the first 100 years of tree growth because of the steep exponential ring-width age trend (Figure 3).

South-to-north and east-to-west comparisons between two transects can indicate site differences not necessarily climatically induced. Nonclimatic factors such as local fire history, plant succession, soil type, and human activity also contribute to different aspects of tree growth.

Cross-dating Matrix Results

Very few dendrochronological studies have been conducted on trees from the boreal forest in Canada, especially with respect to ring density. The first major step is building tree-ring width and density chronologies that serve as a data base for larger and more intensive studies. The next step is to compare chronologies and determine climatic factors that may contribute to annual ring width and density. Further work (beyond the scope of the project described here), would be to add new sites to this network and make a more intensive study of the complex relationships that exist between tree growth and climatic factors.

Year-to-year variability in tree-ring chronologies from various sites is presumably due to common factors that affect these sites. These factors are aspects of climate, primarily temperature and precipitation. (Solar radiation also must be important but site specific data are not generally available for this factor.)

The degree to which these chronologies correspond to one another is examined by the following methods:

(1) by making a visual comparison of the year-to-year variability in the ring width and maximum ring density chronologies of all these sites; and

(2) by determining the relative degree of matching between sites by comparing correlation coefficients derived from matching each site with all other sites (Table 3 and Figure 9).

The cross-dating quality of a tree-ring chronology is important in determining how well a chronology relates to climatic factors and also how satisfactory the chronology may be for dating purposes. An r value of as low as 0.3 can be used to verify a cross-dating match if at least 100 rings are used.

Some basic questions to ask in a study of this scope are:

- What is the correlation between sites, i.e., cross-dating quality, as a function of distance?
- Which parameter, ring width or maximum ring density (as indicated by correlation), relates better to climate?
- Which type of chronology, B & C or C, produces higher correlations when two sites are compared?
- Do northern sites produce higher r values than southern sites?
- Do eastern sites produce higher r values than western sites?

Results of correlation comparisons between sites for ring-width and maximum ring-density chronologies are presented in Table 3 and Figure 9.

Maximum ring density is better for cross-dating purposes because it has a higher r value in all but 14 of the 81 comparisons. The mean of r values for maximum ring density is 0.339 and for ring width is 0.221, indicating that maximum ring density is better-suited for dating.

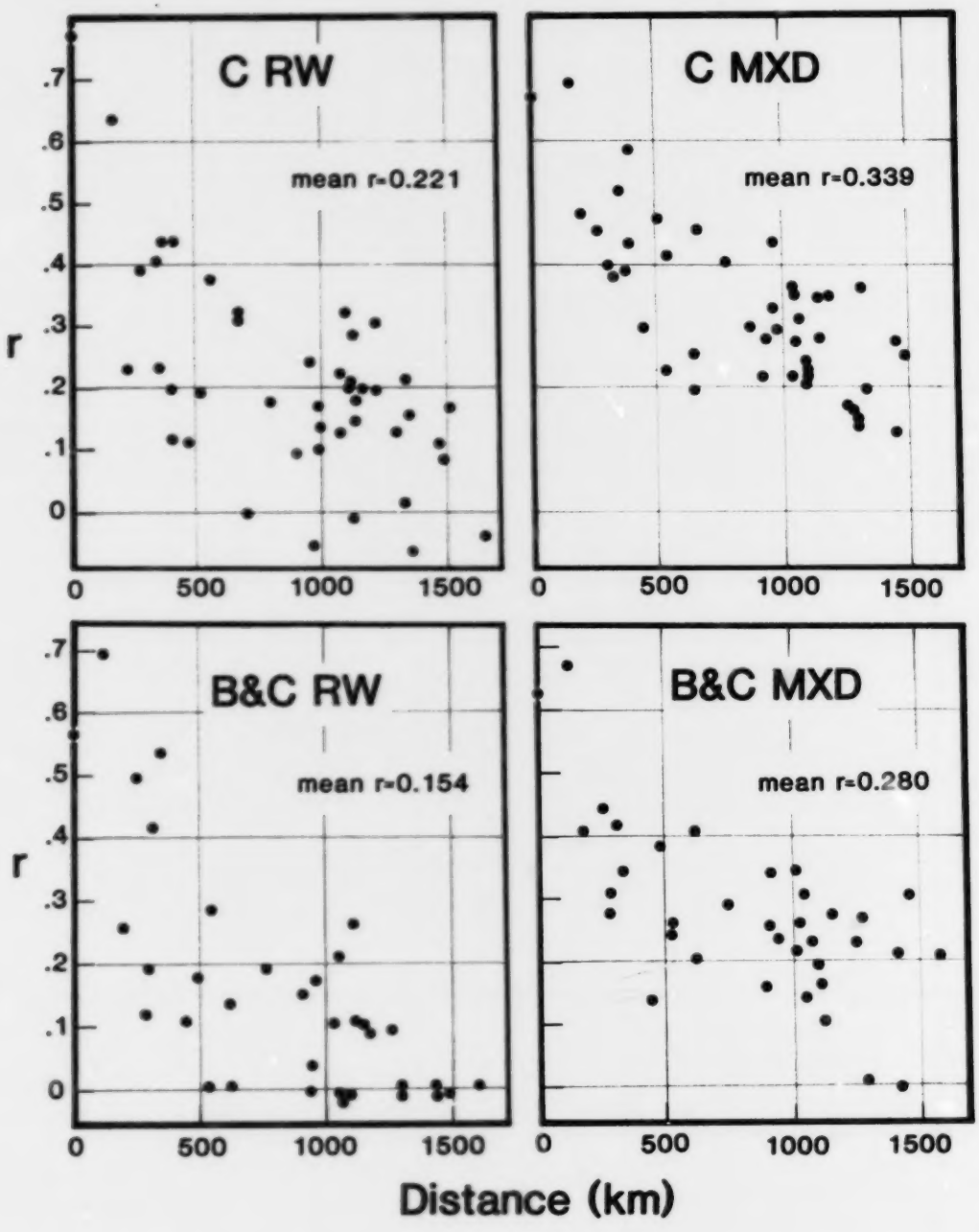


Figure 9. Ring width (RW) and maximum ring density (MXD) C and B & C chronology cross-dating matrix r values plotted as a function of distance between sites being compared.

Table 3. **Between-site cross-correlation comparisons of B & C and C chronologies for ring width and maximum ring density (values of r in italics) for the period 1870–1978**

Alta-NWT Sites	Manitoba Sites	CR bs	SR bs	SR ws	PL	TP	FR	DM	FV	RM	SH	
	Churchill River black spruce (CR bs)		0.205 *0.442*	0.128 *0.597*	0.315 *0.369*	0.013 *0.203*	0.292 *0.253*	0.102 *0.313*	0.021 *0.151*	-0.049 *0.290*	-0.066 *0.210*	
	Suwannee River black spruce (SR bs)			0.781 *0.682*	0.156 *0.230*	0.241 *0.389*	0.175 *0.449*	0.380 *0.236*	0.219 *0.371*	0.325 *0.262*	0.230 *0.358*	
	Suwannee River white spruce (SR ws)		0.570 *0.625*		0.186 *0.220*	0.412 *0.410*	0.112 *0.340*	0.375 *0.421*	0.211 *0.285*	0.329 *0.469*	0.135 *0.230*	
Prelude Lake (PL)			0.114 *0.195*	0.260 *0.154*		0.140 *0.179*	0.238 *0.489*	0.177 *0.264*	0.121 *0.303*	-0.030 *0.164*	0.250 *0.229*	
	The Pas (TP)		0.196 *0.319*	0.123 *0.273*	0.093 *0.236*		-0.001 *0.242*	0.397 *0.464*	0.201 *0.293*	0.448 *0.397*	0.148 *0.304*	C
Fort Resolution (FR)		B & C	0.040 *0.344*	-0.012 *0.253*	0.254 *0.408*	-0.055 *0.231*		0.181 *0.364*	0.423 *0.527*	0.098 *0.285*	0.188 *0.416*	
	Duck Mountain (DM)		0.286 *0.258*	0.001 *0.345*	-0.013 *0.301*	0.496 *0.448*	-0.004 *0.269*		0.225 *0.154*	0.647 *0.702*	0.327 *0.319*	
Fort Vermilion (FV)			-0.055 *0.246*	-0.119 *0.303*	0.134 *0.140*	0.106 *0.104*	0.413 *0.417*	0.051 *0.053*		0.123 *0.142*	0.203 *0.482*	
	Riding Mountain (RM)		0.139 *0.202*	0.032 *0.407*	0.056 *0.219*	0.543 *0.349*	-0.048 *0.213*	0.693 *0.669*	0.052 *-0.001*		0.206 *0.363*	
Swan Hills (SH)			0.102 *0.346*	0.102 *0.225*	0.153 *0.165*	0.168 *0.241*	0.194 *0.290*	0.213 *0.261*	0.177 *0.386*	0.094 *0.266*		

As well, higher correlations are usually obtained for the C chronologies than for the B & C chronologies (Table 3 and Figure 9); the mean of r values is 0.280 for the C chronologies and 0.217 for the B & C chronologies[3]. This suggests the C chronology is better for cross-dating tree-ring samples.

Regarding north-south and east-west site comparisons for black spruce compared with white spruce correlations, a number of observations can be made (Jozsa et al. 1982). As expected, tree-ring series from sites near one another correlate higher than series from sites some distance apart (Figure 9). The range is from a high of r = 0.781 for ring width C chronologies, between the black spruce and white spruce at Suwannee River, to a low of r = 0.119 for ring width B & C chronologies, between Fort Vermilion and Suwannee River white spruce. Highly significant correlations, however, can be obtained between sites that are a great distance apart for maximum ring density, such as between Swan Hills and Suwannee River (r = 0.346).

In relating tree-ring variables to climate factors, other tree-ring studies (Parker and Henoch 1971; Parker 1976) indicated the following:

- in cold climates, highest correlations are between maximum ring density and temperature;
- in dry climates, highest correlations are between ring width and precipitation.

This pattern does not emerge, however, in cross-correlation comparison of sites on the two transects examined in this study. Maximum ring density is better than ring width for cross-dating in both north and south. Moreover, correlations between sites, based on maximum ring density, are no better for the north than for the south.

Climatic Comparison Results

Correlation values for comparing climatic factors with tree-ring parameters are presented in bar-graph plots (Figures 10-15). The following observations can be made from these figures:

- degree of correlation of temperature with tree-ring parameter is generally greater than corresponding values for precipitation;
- values correlating temperature to corresponding maximum ring density data are often higher than similar values based on ring-width relationships, but this is not so when precipitation is involved;
- no marked difference in correlation values exists between northern sites and southern sites;
- comparisons using the B & C chronologies for ring volume and ring weight usually produce higher correlations than the C chronologies for ring width and maximum ring density;
- month-to-month patterns are not the same for all sites; in fact, these patterns can be markedly different (e.g., compare Riding Mountain with Duck Mountain on ring-volume and ring-weight plots (Figures 14 and 15)) and;
- climatic response for one month may be quite different from other months (e.g., Duck Mountain ring-volume and ring-weight comparisons).

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3 Data for the Churchill site were taken from another study (see footnote 1) and the B & C chronologies were not available for this site.

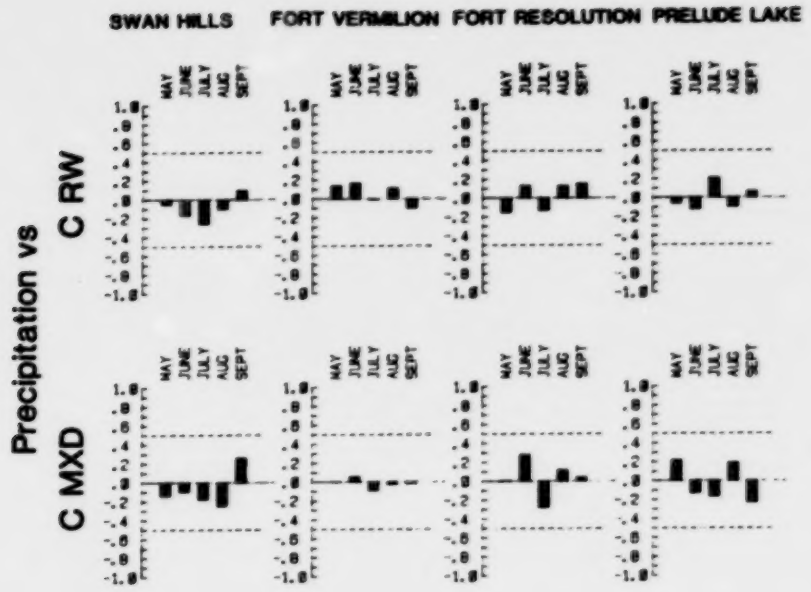

Figure 10. Monthly precipitation vs. tree-ring width (RW) and maximum ring density (MXD) C chronology correlations for the Alta.-NWT Transect white spruce sites.

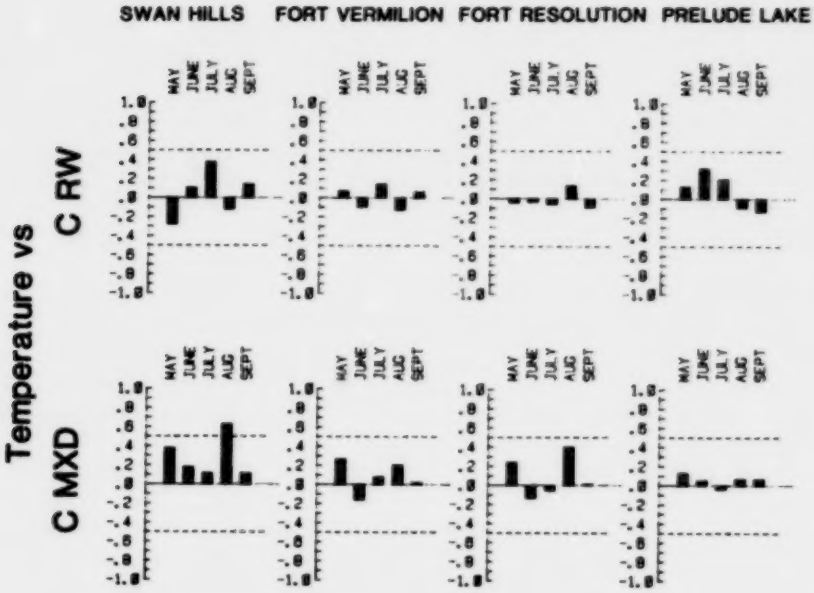

Figure 11. Monthly temperature vs. tree-ring width (RW) and maximum ring density (MXD) C chronology correlations for the Alta.-NWT Transect white spruce sites.

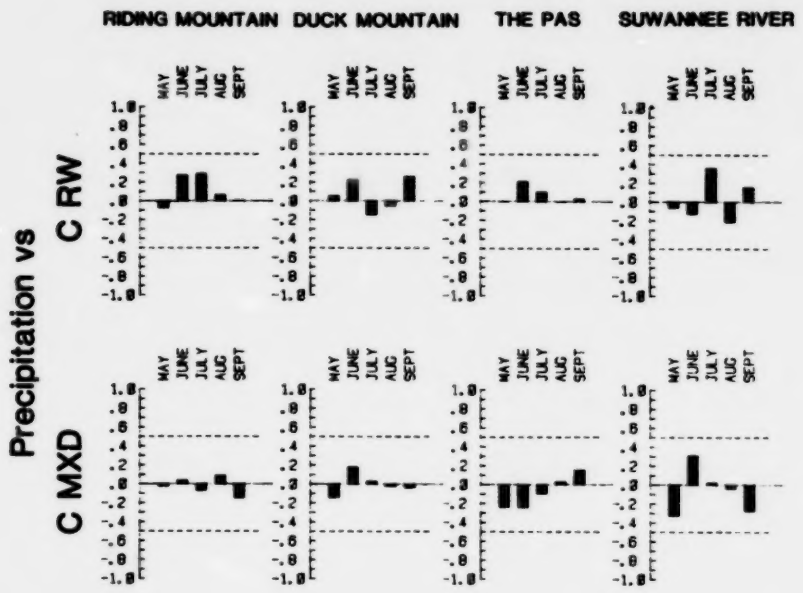

Figure 12. Monthly precipitation vs. tree-ring width (RW) and maximum ring density (MXD) C chronology correlations for the Manitoba Transect white spruce sites.

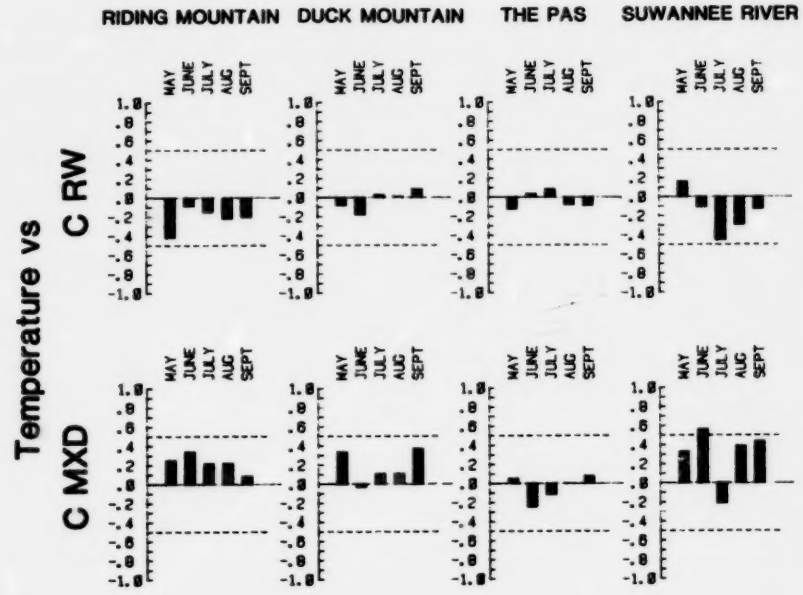

Figure 13. Monthly temperature vs. tree-ring width (RW) and maximum ring density (MXD) C chronology correlations for the Manitoba Transect white spruce sites.

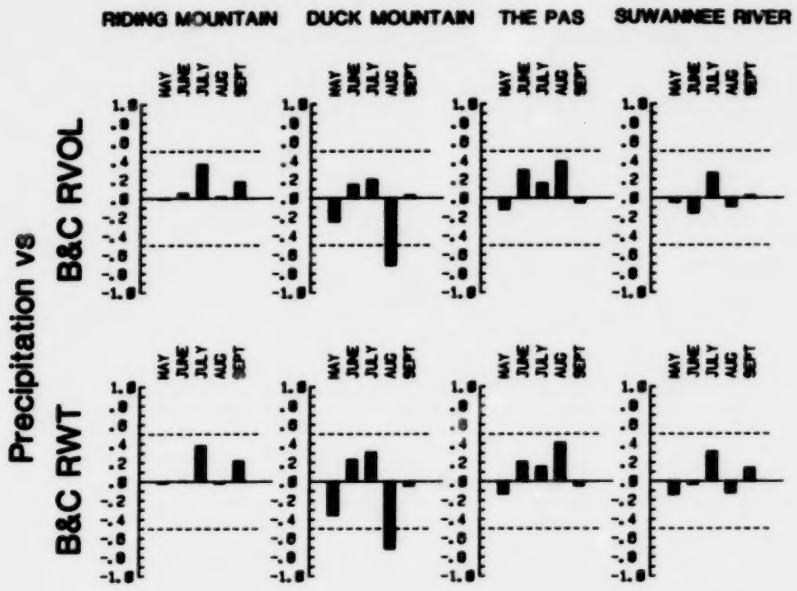

Figure 14. Monthly precipitation vs. tree-ring volume (RVOL) and tree-ring weight (RWT) B & C chronology correlations for the Manitoba Transect white spruce sites.

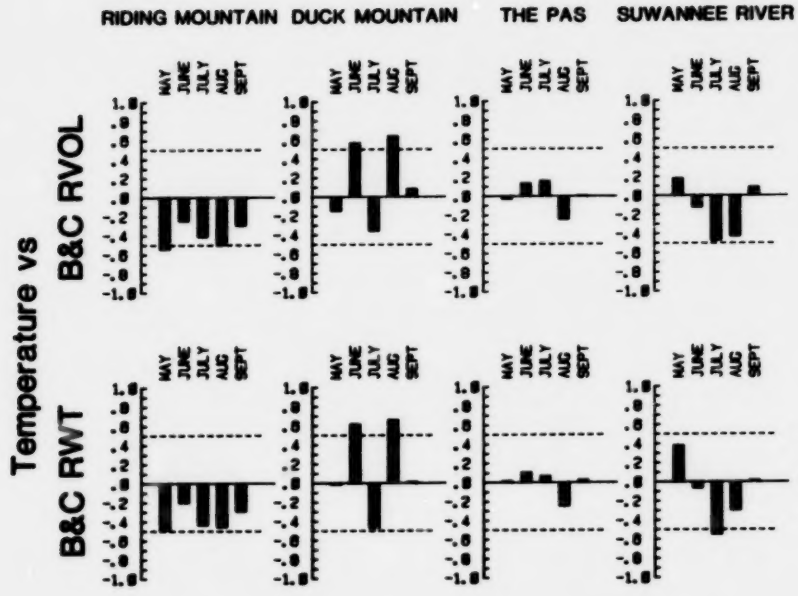

Figure 15. Monthly temperature vs. tree-ring volume (RVOL) and tree-ring weight (RWT) B & C chronology correlations for the Manitoba Transect white spruce.

Although no strong, consistent, clear-cut patterns emerge from correlation comparisons between climate and tree-ring parameters, it has been demonstrated that a strong common climatic signal is contained in tree-rings for the Manitoba Transect sites (Figure 16). Numerous common marker rings are evident in both ring-width and maximum ring-density chronologies. This is indicative of common climatic signals, as recorded in the trees' radial growth, as far as 600 km apart. Also, strong cross-dating between randomly selected individual cores and site summary chronologies are further proof of strong climatic signals, as shown in Table 4 for Manitoba Transect white spruce and black spruce sites.

The RW and MXD site summary chronologies are shown in Figure 17 for the Alta.-NWT Transect. The strong cross-dating character of the Manitoba Transect sites is not duplicated here as sites are being compared from south to north. Only MXD indexes show some harmonious peaks and troughs, notably at 1880, 1888, 1889, 1890, 1906, 1907, and 1958-1961. Of these ring-years, 1880, 1899, 1907, and 1961 show identical depressions on the Manitoba Transect (Figure 16).

Obviously, more sophisticated statistical treatment is required (or even restructuring climate records to solar/growth periods as opposed to monthly records) for better understanding of climate-growth relationships and for climate reconstruction for periods when no climate records were kept.

Table 4. Manitoba Transect individual core and site summary chronology correlations for 100-year-long common time periods

		Ring width (r)	Maximum ring density (r)
Riding Mountain		0.82	0.80
Duck Mountain		0.74	0.76
The Pas		0.73	0.69
Suwannee River	(ws)	0.65	0.86
	(bs)	0.73	0.69

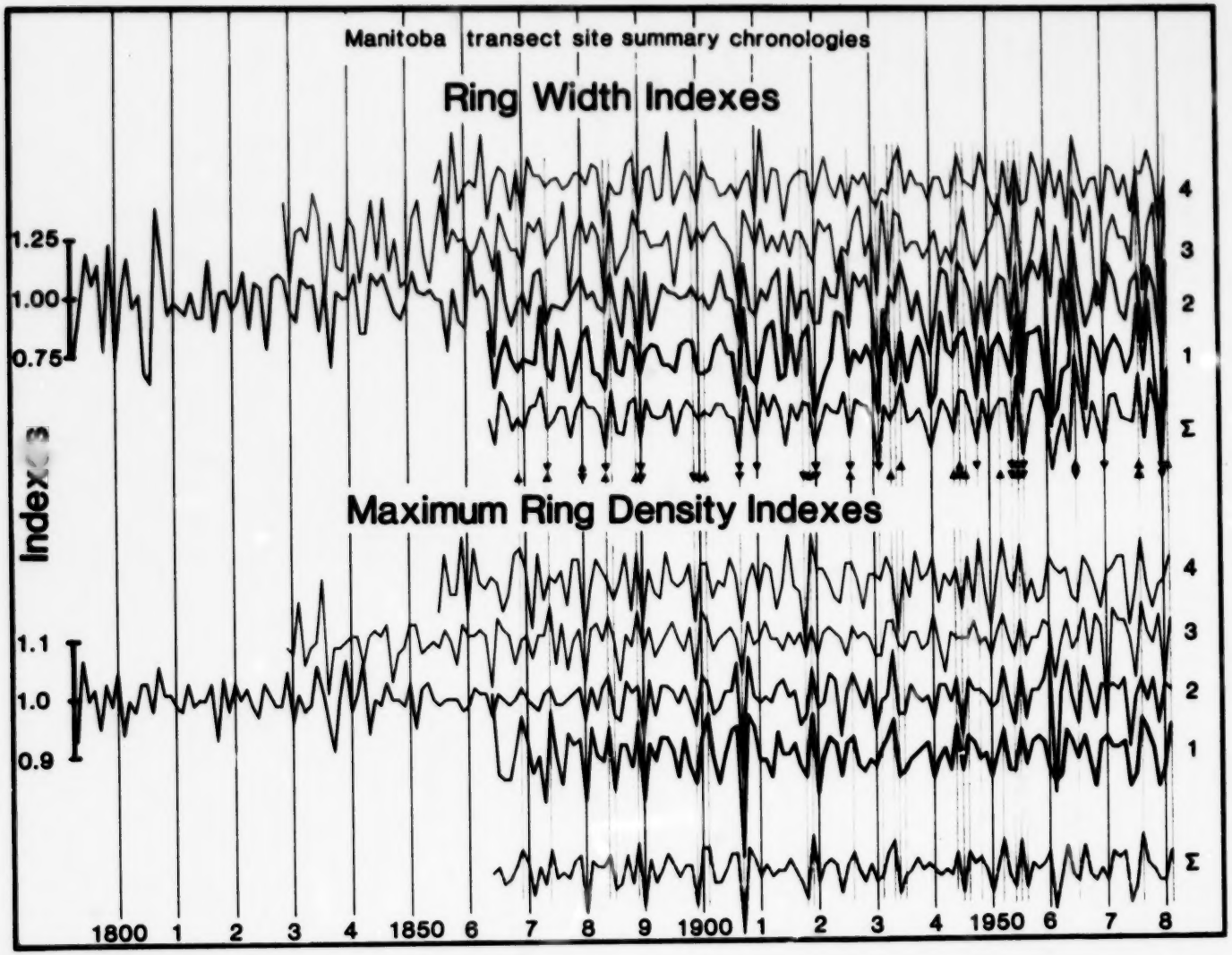

Figure 16. White spruce site summary chronologies for Riding Mountain (1), Duck Mountain (2), The Pas (3) and Suwannee River (4). An overall Manitoba summary is also shown (Σ).

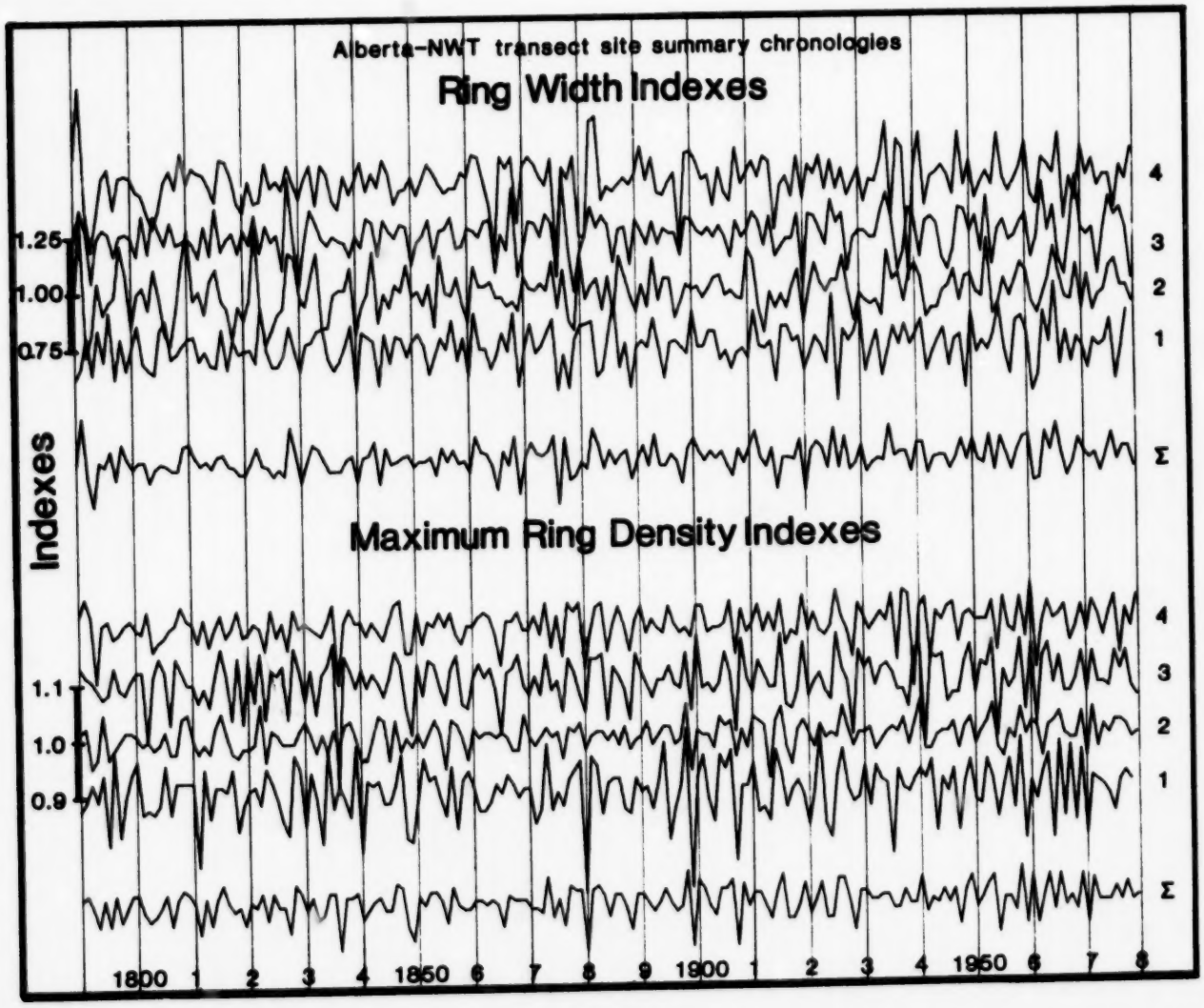

Figure 17. White spruce site summary chronologies for Swan Hills (1), For Vermilion (2), Fort Resolution (3) and Prelude Lake (4). An overall Alta.-NWT Transect summary is also shown (Σ).

CONCLUSIONS AND RECOMMENDATIONS

Extensive and detailed ring-width and ring-density data provided through X-ray densitometry supply useful information for assessing biomass productivity of different geographical areas and for studying relationships between tree growth and climate.

Strong climate-tree growth relationships are indicated by numerous common marker years, by strong cross-dating between randomly selected individual cores and site summary chronologies, and by high correlations between tree-ring chronologies for sites hundreds of kilometres apart. The complexity of these relationships is demonstrated by this study.

A more sophisticated statistical treatment is recommended to better establish the climate-growth relationships for the ultimate use of climate reconstruction for periods when no weather records were kept.

Ring density, although difficult to measure on a year-to-year basis by conventional methods, is an important parameter of wood quality. It is strongly correlated with both strength of wood and pulp yields.

Density determination is essential in evaluating biomass production. Total biomass for an individual tree ring in the stem can be defined as the total weight of the solid wood substance contained in that annual increment. Ring weight of an individual annual ring is the product of its volume and density.

It is recommended the true biomass productivity of different geographical areas be examined by measuring ring weights of entire annual increments by processing tree-ring samples from intensively sampled trees at the extreme northern and southern limits and at a central location of the boreal forest.

It would be informative to compare breast height disks with whole tree statistics because most cruising and stand appraisal inventory work is based on breast height data.

Black spruce is equally well-suited for dendrochronological studies because it has similar growth response to white spruce, provided the tree-ring site is on well-drained soils, not permafrost or bog habitats.

The relatively young (~130 yr.) trees at the Manitoba Transect tree-ring sites produce about twice the biomass at breast height as older trees (~210 yr.) at the Alta.-NWT sites.

South-north and east-west comparisons between the two transects can indicate site differences not necessarily induced climatically. Nonclimatic factors, such as local fire history, plant succession, soil type, and human activities, also contribute to different aspects of tree growth.

REFERENCES

Jozsa, L.A.; Parker, M.L.; Bramhall, P.A.; Johnson, S.G. 1982. Wood production of spruce in Manitoba as a function of climate. Pages 114-119 *in* Proc. Fourth Bioenergy R & D Seminar, Winnipeg, Manit., March 29-31, 1982. National Research Council of Canada, Ottawa, Ont.

Kellogg, R.M.; Steucek, G.L. 1980. Mechanical stimulation and xylem production in Douglas-fir. For. Sci. 26(4):643-651.

Kusec, D.J. 1972. Twin-blade saw for precision machining of increment cores. Wood and Fiber 4(1):44-49.

Layser, E.F. 1980. Forestry and climatic change. J. For. 78(11): 678-682.

Parker, M.L. 1970. Dendrochronological techniques used by the Geological Survey of Canada. Pages 55-66 *in* J.H.G. Smith and J. Worrall, eds. Tree-ring analysis with special reference to northwest America. Univ. British Columbia, Fac. For. Bull. 7

Parker, M.L. 1976. Improving tree-ring dating in northern Canada by X-ray densitometry. Syesis 9:163-172.

Parker, M.L.; Bruce, R.D.; Jozsa, L.A. 1977. Calibration, data acquisition and processing procedures used with an on-line tree-ring scanning densitometer. Int. Union For. Res. Organ., Group P4.01.05 Meeting, September 1977, Corvallis, Oregon.

Parker, M.L.; Bruce, R.D.; Jozsa, L.A. 1980. X-ray densitometry of wood at the W.F.P.L. Forintek Canada Corp., Western Laboratory, Tech. Rep. 10:1-18.

Parker, M.L; Henoch, W.E.S. 1971. The use of Engelmann spruce latewood density for dendrochronological purposes. Can. J. For. Res. 1(2): 90-98.

Parker, M.L.; Jozsa, L.A. 1973. X-ray scanning machine for tree-ring width and density analysis. Wood and Fiber 5(3):192-197.

Parker, M.L.; Jozsa, L.A. 1977. What tree rings tell us. Can. For. Serv., Ottawa, Ont., unnumbered Forest Fact Sheet.

Parker, M.L.; Jozsa, L.A.; Bramhall, P.A.; Johnson, S.G. 1981a. The effect of climatic variation on tree rings of spruce from the western Canadian Boreal Forest. Pages 36-40 *in* Proc. Third Bioenergy R & D Seminar, Ottawa, March 24-25, 1981. National Research Council of Canada, Ottawa, Ont.

Parker, M.L.; Jozsa, L.A.; Johnson, S.G.; Bramhall, P. 1981b. Dendrochronological studies on the coasts of James Bay and Hudson Bay. Syllogeus 33:129-188.

Parker, M.L.; Kennedy, R.W. 1973. The status of radiation densitometry for measurement of wood specific gravity. Pages 882-893 *in* Proc. Int. Union For. Res. Organ., Div. 5 Meetings, September-October 1973, Cape Town and Pretoria, South Africa.

Parker, M.L.; Schoorlemmer, J.L.; Carver, L.J. 1973. A computerized scanning densitometer for automatic recording of tree-ring width and density data from X-ray negatives. Wood and Fiber 5(3):237-248.

Polge, H. 1963. L'analyse densitométrique de clichés radiographiques: une nouvelle méthode de détermination de la texture du bois. Ann. Ec. Natl. Eaux Forêts, St. Rech. Expér. 20(4):530-581.

Polge, H. 1966. Etablissement des courbes de variation de la densité du bois par exploration densitométrique de radiographies d'échantillons prélevés à la tarière sur des arbres vivants. Ann. Sci. For., 23(1):1-206.

Powell, J.M. 1981. Impact of climatic variation on boreal forest biomass production. Syllogeus 33: 189-194.

Rowe, J.S. 1967. Phytogeographic zonation: an ecological application. Pages 12-27 *in* R.J. Taylor and R.A. Ludwig, eds. The evolution of Canada's flora. University of Toronto Press, Toronto, Ont.

Rowe, J.S. 1972. Forest regions of Canada. Environ. Can., Can. For. Serv. Publ. 1300.

Western Forest Products Laboratory. 1979. Western Forest Products Laboratory Program Review 1977 & 1978. Environ. Can., Can. For. Serv. Vancouver, B.C.

APPENDIX 1

Alberta-NWT Transect chronologies from south to north.

Swan Hills

Fort Vermilion

Fort Resolution

Prelude Lake

SWAN HILLS SELECT RING WIDTH "B" CHRONOLOGY
YEARS: 1651 1978

	TREE RING INDICES										NUMBER OF RADII									
DATE	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
1650		.77	.86	.96	1.14	1.17	1.20	1.18	1.11	1.00		1	1	1	3	3	3	3	3	4
1660	.95	.93	.93	.95	.97	.96	.96	.95	.97	.98	5	5	5	5	5	5	5	5	5	5
1670	.99	.97	.94	.92	.92	.94	.96	.98	1.00	1.00	6	6	6	6	6	6	6	6	6	7
1680	1.01	1.03	1.03	1.03	1.03	1.04	1.01	1.05	1.07	1.09	7	7	7	7	7	7	8	8	8	8
1690	1.08	1.05	1.01	.98	.96	.95	.94	.94	.93	.90	8	8	8	8	8	8	8	8	8	8
1700	.86	.82	.80	.78	.80	.82	.84	.87	.90	.95	8	8	8	8	8	8	8	8	8	8
1710	1.01	1.05	1.07	1.06	1.03	1.01	.99	.97	.93	.89	9	9	9	9	9	9	9	9	9	9
1720	.89	.92	.98	1.04	1.09	1.11	1.11	1.10	1.09	1.07	9	9	9	9	9	9	9	9	9	9
1730	1.05	1.03	1.02	1.01	.98	.94	.90	.88	.87	.86	9	9	9	9	9	9	9	9	9	9
1740	.86	.86	.87	.90	.95	.99	1.01	1.02	1.02	1.02	9	9	9	9	9	9	9	9	9	9
1750	1.01	1.00	1.00	1.02	1.05	1.07	1.07	1.04	1.00	.98	9	9	9	9	9	9	9	9	9	9
1760	.96	.96	.96	.94	.94	.95	.97	.99	1.00	1.00	9	9	9	10	10	10	10	10	10	10
1770	1.00	1.03	1.07	1.10	1.11	1.09	1.07	1.05	1.05	1.05	11	11	11	11	11	11	11	11	11	11
1780	1.04	1.03	1.02	1.02	1.01	1.02	1.02	1.00	.96	.91	11	11	11	11	11	11	11	11	11	11
1790	.87	.85	.87	.90	.94	.96	.98	.97	.96	.95	11	11	11	11	11	11	11	11	11	11
1800	.95	.95	.95	.98	1.03	1.09	1.13	1.15	1.14	1.13	11	12	12	12	12	12	12	13	13	13
1810	1.10	1.06	1.01	.98	.95	.93	.93	.93	.94	.96	13	13	13	14	14	14	14	14	14	14
1820	.98	1.00	1.02	1.03	1.01	.99	.98	.99	1.00	1.02	14	14	14	14	14	14	14	14	14	14
1830	1.04	1.06	1.08	1.08	1.04	.99	.94	.90	.88	.88	14	14	14	14	14	14	14	14	14	14
1840	.88	.88	.88	.88	.88	.90	.93	.96	.99	1.02	14	14	14	14	14	14	14	14	14	14
1850	1.03	1.02	1.01	1.00	1.01	1.05	1.08	1.10	1.10	1.09	14	14	14	14	14	14	14	14	14	14
1860	1.06	1.05	1.02	.98	.97	.98	.99	1.01	1.02	1.02	14	13	13	13	13	13	13	13	13	13
1870	1.03	1.03	1.03	1.02	.98	.94	.90	.89	.92	.98	13	13	13	13	13	13	13	13	13	13
1880	1.05	1.08	1.07	1.03	1.01	1.00	.98	.94	.90	.88	13	13	13	13	13	13	13	13	13	13
1890	.88	.92	.95	.97	.98	1.00	1.03	1.08	1.14	1.19	13	13	13	13	13	13	13	13	13	13
1900	1.22	1.22	1.19	1.14	1.06	.98	.91	.86	.85	.87	13	13	13	13	13	13	13	13	13	13
1910	.90	.93	.95	.94	.94	.95	.97	.98	.97	.95	13	13	13	13	13	13	13	13	13	13
1920	.93	.92	.93	.94	.96	.97	.99	1.01	1.04	1.05	13	13	13	13	13	13	13	13	13	13
1930	1.04	1.01	.97	.95	.95	.98	1.01	1.04	1.06	1.06	13	13	13	13	13	13	13	13	13	13
1940	1.05	1.02	.99	.97	.96	.95	.94	.92	.92	.92	13	13	13	13	13	13	13	13	13	13
1950	.94	.97	1.01	1.04	1.07	1.08	1.08	1.07	1.05	1.02	13	13	13	13	13	13	13	13	13	13
1960	.98	.96	.98	1.05	1.11	1.12	1.08	1.01	.95	.89	13	13	13	13	13	13	13	13	13	13
1970	.87	.86	.87	.90	.94	.99	1.05	1.12	1.21		13	13	13	13	13	13	13	13	13	

SWAN HILLS SELECT RING WIDTH "C" CHRONOLOGY
YEARS: 1651 1978

TREE RING INDICES

DATE	0	1	2	3	4	5	6	7	8	9
1650		1.06	1.25	.73	.93	1.00	1.03	1.20	1.09	.88
1660	.98	.97	.86	1.06	1.10	1.02	.94	.95	.97	1.02
1670	1.17	.94	.95	1.02	.85	1.12	.96	.98	.99	1.05
1680	.94	1.00	.96	1.01	.99	.97	.97	1.03	.97	1.06
1690	1.09	1.02	.87	1.02	1.00	.96	.97	1.05	1.09	.90
1700	1.16	.86	.95	.90	.93	.93	1.12	1.01	.91	.87
1710	1.09	1.05	1.02	1.12	.87	.95	1.07	1.11	.95	.94
1720	.93	.81	1.11	1.01	1.10	.96	1.12	.89	.98	1.09
1730	1.03	.83	1.07	1.04	1.13	.83	1.03	.97	.91	1.17
1740	.86	1.04	.99	.87	.97	1.15	1.02	.93	1.05	.99
1750	1.07	.91	.94	1.02	1.01	.99	1.13	1.03	.92	.95
1760	.97	1.00	.93	1.10	.88	1.00	.99	.99	1.10	1.00
1770	.90	.93	1.02	1.12	1.01	1.02	.99	.88	1.07	.99
1780	1.04	.96	1.05	.96	.97	.99	1.04	1.06	1.05	1.01
1790	.85	.91	1.07	.89	1.00	.94	1.19	.88	1.00	.91
1800	.97	1.13	.94	.90	.89	1.11	1.13	.97	.97	1.03
1810	1.04	1.06	.95	.99	.95	.94	1.00	.91	1.04	.97
1820	.99	1.00	.94	1.10	1.02	.91	.91	.90	1.10	.99
1830	.89	1.03	1.02	1.09	1.00	.94	.94	.94	1.00	1.10
1840	.00	1.00	1.05	1.02	.83	1.04	.97	1.02	1.04	.95
1850	1.04	1.00	1.01	.86	.95	1.02	.99	1.12	.97	1.05
1860	.89	1.14	.97	.97	.91	.96	1.07	.96	1.14	.84
1870	.99	1.11	.90	.99	1.06	1.11	.79	.97	.82	1.04
1880	1.07	1.14	1.10	.85	.00	1.06	1.20	.91	1.02	.79
1890	.99	1.04	.90	1.13	.90	.04	1.01	1.04	1.00	.93
1900	1.16	1.01	1.00	1.05	1.06	.92	.97	.00	.96	.90
1910	.93	1.14	1.01	.99	1.02	.01	1.10	1.07	1.02	1.03
1920	.09	.96	1.05	.97	.93	1.23	.74	1.00	.99	1.06
1930	1.14	.07	.97	1.04	.05	.99	1.07	.90	1.07	.96
1940	1.04	1.10	.06	.95	1.02	1.11	.90	1.02	1.02	.00
1950	1.15	.96	.97	.95	1.06	1.17	.90	.09	1.11	1.11
1960	1.03	.73	.03	1.12	1.01	1.27	.91	1.04	.07	1.02
1970	.90	.90	.99	.90	.90	1.09	.02	.90	1.11	

NUMBER OF RADII

0	1	2	3	4	5	6	7	8	9
	1	1	1	3	3	3	3	3	4
5	5	5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6	6	7
7	7	7	7	7	7	8	8	8	8
8	8	8	8	8	8	8	8	8	8
8	8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9	9
9	9	9	9	9	9	9	9	9	9
9	9	9	9	9	9	9	9	9	9
9	9	9	9	9	9	9	9	9	9
9	9	9	9	9	9	9	9	9	9
9	9	9	10	10	10	10	10	10	10
11	11	11	11	11	11	11	11	11	11
11	11	11	11	11	11	11	11	11	11
11	11	11	11	11	11	11	11	11	11
11	12	12	12	12	12	12	13	13	13
13	13	13	14	14	14	14	14	14	14
14	14	14	14	14	14	14	14	14	14
14	14	14	14	14	14	14	14	14	14
14	14	14	14	14	14	14	14	14	14
14	14	14	14	14	14	14	14	14	14
14	13	13	13	13	13	13	13	13	13
13

SWAN HILLS SELECT RING WIDTH "B&C" CHRONOLOGY
YEARS: 1651 1978

	TREE RING INDICES										NUMBER OF RADII									
DATE	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
1650		.81	1.08	.70	1.06	1.18	1.23	1.41	1.21	.88		1	1	1	3	3	3	3	3	4
1660	.93	.90	.80	1.02	1.07	.98	.90	.90	.93	.99	5	5	5	5	5	5	5	5	5	5
1670	1.16	.91	.89	.94	.78	1.05	.92	.97	1.00	1.06	6	6	6	6	6	6	6	6	6	7
1680	.96	1.10	.99	1.04	1.02	1.01	.99	1.08	1.04	1.16	7	7	7	7	7	7	8	8	8	8
1690	1.18	1.08	.88	1.00	.96	.91	.92	.98	1.02	.81	8	8	8	8	8	8	8	8	8	8
1700	.99	.72	.77	.78	.75	.75	.95	.88	.83	.83	8	8	8	8	8	8	8	8	8	8
1710	1.11	1.11	1.10	1.19	.89	.96	1.07	1.07	.88	.84	9	9	9	9	9	9	9	9	9	9
1720	.83	.74	1.09	1.06	1.20	1.07	1.25	.98	1.07	1.17	9	9	9	9	9	9	9	9	9	9
1730	1.08	.86	1.10	1.05	1.11	.78	.93	.85	.79	1.01	9	9	9	9	9	9	9	9	9	9
1740	.74	.90	.87	.79	.92	1.13	1.03	.95	1.08	1.01	9	9	9	9	9	9	9	9	9	9
1750	1.08	.91	.94	1.04	1.06	1.06	1.21	1.07	.92	.93	9	9	9	9	9	9	9	9	9	9
1760	.93	1.03	.89	1.04	.83	.95	.96	.99	1.10	1.00	9	9	9	10	10	10	10	10	10	10
1770	.90	.96	1.10	1.23	1.12	1.11	1.07	.93	1.11	1.04	11	11	11	11	11	11	11	11	11	11
1780	1.08	.99	1.07	.98	.98	1.01	1.05	1.06	1.01	.92	11	11	11	11	11	11	11	11	11	11
1790	.74	.77	.93	.80	1.01	.91	1.16	.85	1.04	.88	11	11	11	11	11	11	11	11	11	11
1800	.93	1.08	.89	.88	.91	1.21	1.28	1.11	1.11	1.16	11	12	12	12	12	12	12	13	13	13
1810	1.14	1.12	.96	.97	.90	.87	1.00	.85	.98	.94	13	13	13	14	14	14	14	14	14	14
1820	.98	1.00	.96	1.21	1.03	.91	.90	.97	1.10	1.01	14	14	14	14	14	14	14	14	14	14
1830	.93	1.10	1.11	1.17	1.13	.93	.89	.86	.88	.97	14	14	14	14	14	14	14	14	14	14
1840	.70	.96	.93	.90	.73	.93	.90	.99	1.04	.96	14	14	14	14	14	14	14	14	14	14
1850	1.07	1.11	1.02	.86	.97	1.07	1.07	1.24	1.07	1.14	14	14	14	14	14	14	14	14	14	14
1860	.95	1.20	.98	.96	.89	.94	1.06	.97	1.16	.86	14	13	13	13	13	13	13	13	13	13
1870	1.02	1.15	1.01	1.01	1.05	1.04	.71	.86	.75	1.02	13	13	13	13	13	13	13	13	13	13
1880	1.12	1.23	1.18	.88	.89	1.06	1.18	.85	.92	.69	13	13	13	13	13	13	13	13	13	13
1890	.88	.95	.93	1.09	.97	.84	1.04	1.12	1.14	1.10	13	13	13	13	13	13	13	13	13	13
1900	1.42	1.23	1.19	1.21	1.13	.90	.88	.77	.83	.85	13	13	13	13	13	13	13	13	13	13
1910	.84	1.06	.96	.94	.97	.77	1.07	1.05	.99	.98	13	13	13	13	13	13	13	13	13	13
1920	.83	.89	.98	.92	.88	1.19	.73	1.09	1.02	1.13	13	13	13	13	13	13	13	13	13	13
1930	1.20	.89	.94	.99	.82	.96	1.08	1.02	1.14	1.03	13	13	13	13	13	13	13	13	13	13
1940	1.09	1.12	.85	.92	.98	1.06	.85	.94	.93	.74	13	13	13	13	13	13	13	13	13	13
1950	1.09	.93	.98	1.00	1.13	1.26	.98	.95	1.17	1.14	13	13	13	13	13	13	13	13	13	13
1960	1.02	.70	.81	1.18	1.11	1.43	.99	1.06	.82	.91	13	13	13	13	13	13	13	13	13	13
1970	.85	.78	.87	.88	.92	1.07	.86	1.11	1.34		13	13	13	13	13	13	13	13	13	

SWAN HILLS SELECT MAXIMUM DENSITY "D" CHRONOLOGY
YEARS: 1651 1978

	TREE RING INDICES										NUMBER OF RADII									
DATE	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
1650		1.00	1.02	1.03	1.02	1.02	1.03	1.03	1.02	1.01		1	1	1	3	3	3	3	3	4
1660	1.01	1.01	1.01	1.00	.99	.97	.96	.95	.96	.97	5	5	5	5	5	5	5	5	5	5
1670	.99	1.01	1.01	1.00	.99	.99	.98	1.00	1.02	1.05	6	6	6	6	6	6	6	6	6	7
1680	1.06	1.06	1.04	1.02	1.00	.98	.98	.98	.98	.97	7	7	7	7	7	7	8	8	8	8
1690	.98	1.00	1.01	1.02	1.01	.99	.96	.94	.92	.92	8	8	8	8	8	8	8	8	8	8
1700	.94	.96	.98	.99	.98	.98	.98	.98	.98	1.00	8	8	8	8	8	8	8	8	8	8
1710	1.02	1.04	1.05	1.05	1.05	1.04	1.03	1.03	1.02	1.02	9	9	9	9	9	9	9	9	9	9
1720	1.02	1.03	1.04	1.04	1.03	1.01	.99	.98	.97	.95	9	9	9	9	9	9	9	9	9	9
1730	.94	.94	.95	.98	1.00	1.01	1.01	1.00	.98	.96	9	9	9	9	9	9	9	9	9	9
1740	.95	.94	.94	.95	.96	.99	1.01	1.02	1.03	1.03	9	9	9	9	9	9	9	9	9	9
1750	1.02	1.02	1.02	1.03	1.04	1.05	1.05	1.03	1.00	.98	9	9	9	9	9	9	9	9	9	9
1760	.96	.96	.97	.97	.98	1.00	1.02	1.03	1.03	1.02	9	9	9	10	10	10	10	10	10	10
1770	1.01	1.02	1.03	1.05	1.04	1.03	1.01	1.00	1.00	1.00	11	11	11	11	11	11	11	11	11	11
1780	1.00	.99	.98	.97	.96	.95	.95	.95	.96	.97	11	11	11	11	11	11	11	11	11	11
1790	.98	.99	1.00	1.01	1.01	1.01	1.02	1.03	1.03	1.03	11	11	11	11	11	11	11	11	11	11
1800	1.02	1.00	.99	.99	1.01	1.03	1.04	1.05	1.04	1.01	11	12	12	12	12	12	12	13	13	13
1810	.98	.96	.96	.97	.99	1.00	1.01	1.00	1.00	1.01	13	13	13	14	14	14	14	14	14	14
1820	1.02	1.04	1.05	1.05	1.03	1.01	1.00	1.00	1.01	1.01	14	14	14	14	14	14	14	14	14	14
1830	1.01	1.00	.98	.97	.97	.97	.96	.96	.96	.95	14	14	14	14	14	14	14	14	14	14
1840	.95	.96	.97	.97	.98	.98	.97	.96	.95	.96	14	14	14	14	14	14	14	14	14	14
1850	1.00	1.03	1.05	1.06	1.05	1.04	1.03	1.03	1.03	1.03	14	14	14	14	14	14	14	14	14	14
1860	1.01	.99	.98	.99	1.01	1.03	1.04	1.03	1.02	1.00	14	13	13	13	13	13	13	13	13	13
1870	.98	.97	.97	.97	.98	.98	.99	.99	.99	.98	13	13	13	13	13	13	13	13	13	13
1880	.97	.98	1.00	1.01	1.02	1.02	1.01	1.00	1.00	1.00	13	13	13	13	13	13	13	13	13	13
1890	1.01	1.02	1.02	1.01	1.01	1.00	.99	.99	.99	.99	13	13	13	13	13	13	13	13	13	13
1900	1.00	1.02	1.04	1.06	1.07	1.07	1.04	1.01	.99	.97	13	13	13	13	13	13	13	13	13	13
1910	.96	.95	.95	.97	.99	1.00	1.00	.99	.98	.97	13	13	13	13	13	13	13	13	13	13
1920	.97	.97	.98	.98	.99	1.01	1.03	1.03	1.03	1.03	13	13	13	13	13	13	13	13	13	13
1930	1.03	1.02	1.01	.99	.96	.95	.96	.98	1.00	1.02	13	13	13	13	13	13	13	13	13	13
1940	1.03	1.03	1.02	1.01	1.00	.99	.98	.98	.99	1.00	13	13	13	13	13	13	13	13	13	13
1950	1.00	1.01	1.01	1.00	1.01	1.01	1.01	1.01	1.00	.99	13	13	13	13	13	13	13	13	13	13
1960	.98	.99	1.00	1.00	1.01	1.01	1.00	1.00	.99	.97	13	13	13	13	13	13	13	13	13	13
1970	.97	.96	.97	.97	.98	1.00	1.03	1.07	1.11		13	13	13	13	13	13	13	13	13	

SWAN HILLS SELECT MAXIMUM DENSITY "C" CHRONOLOGY
YEARS: 1651 1978

TREE RING INDICES

DATE	0	1	2	3	4	5	6	7	8	9
1650		.98	1.04	.95	1.05	.91	1.05	1.05	1.01	1.00
1660	.92	1.06	.96	1.06	1.07	.88	1.08	.97	.91	1.04
1670	1.00	1.04	.99	1.06	.93	1.06	.95	.93	1.00	1.07
1680	1.00	1.04	.94	1.04	1.07	.83	1.00	1.11	.93	1.03
1690	.92	1.01	1.07	.98	1.03	1.05	.95	1.02	.99	.84
1700	1.06	1.01	1.05	1.02	.95	.99	1.06	1.02	.88	.99
1710	1.03	1.01	1.04	.98	1.05	.93	1.03	1.03	.95	1.01
1720	1.00	.98	1.01	1.03	1.10	.86	1.02	1.02	1.07	.98
1730	1.02	.95	1.01	.95	1.06	1.04	1.02	1.01	.92	1.08
1740	.99	.97	.91	1.05	1.02	.94	1.02	1.01	1.09	.92
1750	1.04	1.03	.98	1.01	.99	1.07	1.02	.99	1.00	1.02
1760	.91	.97	1.06	1.01	.95	.98	1.03	1.01	1.09	.95
1770	.94	.98	1.03	1.06	1.00	1.02	.98	.94	.99	1.06
1780	1.10	.83	1.02	1.08	1.02	.88	1.00	1.00	1.04	.98
1790	.96	1.00	1.03	1.00	1.06	.87	1.12	.91	1.00	1.05
1800	1.00	.94	.97	.96	.99	1.00	.96	1.03	1.02	1.04
1810	1.03	.82	1.06	.95	1.03	1.03	1.00	1.06	.92	.98
1820	1.01	1.03	.98	1.06	1.03	.98	.96	.91	1.07	1.07
1830	.93	1.06	.99	.98	1.09	.96	1.02	.98	.97	1.11
1840	.86	1.03	1.03	1.02	.98	.99	1.01	1.09	.91	.88
1850	.99	1.09	1.03	1.02	.99	.94	1.06	.93	1.03	1.05
1860	1.00	.96	.96	.97	1.03	.99	1.05	1.02	1.00	1.01
1870	1.01	.93	.95	1.11	.96	1.00	.97	1.02	1.05	1.00
1880	.77	1.09	1.04	.95	1.03	1.04	1.02	.95	.95	1.02
1890	1.01	1.03	.95	1.02	1.10	.88	.97	1.03	1.14	.77
1900	1.02	1.00	.98	.93	1.07	1.05	1.09	.85	1.02	1.00
1910	1.05	.95	.96	.94	1.00	1.05	.98	.99	1.04	.99
1920	.89	1.02	1.13	.94	.89	1.04	1.00	.99	.98	.99
1930	1.04	.95	1.00	1.00	1.00	.87	1.03	1.01	.99	1.00
1940	1.05	1.00	1.07	.98	1.02	1.00	1.05	.98	.99	1.07
1950	.99	.97	1.04	1.00	.96	1.00	1.04	.96	1.11	.98
1960	1.00	.93	1.06	1.07	.88	1.11	.94	1.07	.93	1.09
1970	.88	1.04	1.02	.99	.98	.94	.99	1.05	1.01	

NUMBER OF RADII

0	1	2	3	4	5	6	7	8	9
	1	1	1	3	3	3	3	3	4
5	5	5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6	6	7
7	7	7	7	7	7	8	8	8	8
8	8	8	8	8	8	8	8	8	8
8	8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9	9
9	9	9	9	9	9	9	9	9	9
9	9	9	9	9	9	9	9	9	9
9	9	9	9	9	9	9	9	9	9
9	9	9	9	9	9	9	9	9	9
9	9	9	10	10	10	10	10	10	10
11	11	11	11	11	11	11	11	11	11
11	11	11	11	11	11	11	11	11	11
11	11	11	11	11	11	11	11	11	11
11	12	12	12	12	12	12	13	13	13
13	13	13	14	14	14	14	14	14	14
14	14	14	14	14	14	14	14	14	14
14	14	14	14	14	14	14	14	14	14
14	14	14	14	14	14	14	14	14	14
14	14	14	14	14	14	14	14	14	14
14	13	13	13	13	13	13	13	13	13
13

SWAN HILLS SELECT MAXIMUM DENSITY "B&C" CHRONOLOGY
YEARS: 1651 1978

	TREE RING INDICES										NUMBER OF RADII									
DATE	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
1650		.98	1.06	.98	1.07	.93	1.08	1.08	1.03	1.01		1	1	1	3	3	3	3	3	4
1660	.93	1.07	.96	1.07	1.06	.85	1.03	.92	.88	1.01	5	5	5	5	5	5	5	5	5	5
1670	.99	1.05	.99	1.06	.92	1.04	.93	.93	1.03	1.12	6	6	6	6	6	6	6	6	6	7
1680	1.06	1.10	.98	1.07	1.07	.82	.98	1.09	.91	1.00	7	7	7	7	7	7	8	8	8	8
1690	.98	1.01	1.08	1.00	1.03	1.04	.91	.96	.91	.77	8	8	8	8	8	8	8	8	8	8
1700	.99	.98	1.03	1.01	.94	.97	1.04	.99	.86	.98	8	8	8	8	8	8	8	8	8	8
1710	1.04	1.05	1.10	1.04	1.10	.97	1.07	1.06	.97	1.03	9	9	9	9	9	9	9	9	9	9
1720	1.02	1.01	1.05	1.07	1.12	.87	1.02	1.00	1.04	.86	9	9	9	9	9	9	9	9	9	9
1730	.96	.89	.96	.92	1.06	1.05	1.02	1.01	.91	1.05	9	9	9	9	9	9	9	9	9	9
1740	.94	.91	.85	1.00	.98	.93	1.02	1.04	1.12	.95	9	9	9	9	9	9	9	9	9	9
1750	1.06	1.05	.92	1.04	1.03	1.13	1.07	1.02	1.00	.99	9	9	9	9	9	9	9	9	9	9
1760	.88	.93	1.02	.98	.93	.98	1.05	1.04	1.12	.97	9	9	9	10	10	10	10	10	10	10
1770	.94	.99	1.07	1.11	1.05	1.05	.99	.94	.99	1.06	11	11	11	11	11	11	11	11	11	11
1780	1.10	.82	1.00	1.05	.98	.84	.95	.96	1.01	.95	11	11	11	11	11	11	11	11	11	11
1790	.94	.99	1.03	1.01	1.07	.89	1.15	.94	1.04	1.08	11	11	11	11	11	11	11	11	11	11
1800	1.10	.94	.95	.95	1.00	1.10	.99	1.09	1.06	1.05	11	12	12	12	12	12	12	13	13	13
1810	1.01	.79	1.01	.92	1.02	1.03	1.01	1.06	.92	.98	13	13	13	14	14	14	14	14	14	14
1820	1.03	1.06	1.03	1.11	1.07	.99	.96	.91	1.08	1.09	14	14	14	14	14	14	14	14	14	14
1830	.94	1.06	.97	.88	1.06	.93	.99	.94	.93	1.06	14	14	14	14	14	14	14	14	14	14
1840	.83	.98	.99	1.00	.95	.97	.98	1.05	.87	.86	14	14	14	14	14	14	14	14	14	14
1850	.99	1.13	1.09	1.08	1.04	.98	1.09	.96	1.07	1.08	14	14	14	14	14	14	14	14	14	14
1860	1.01	.95	.95	.96	1.04	1.01	1.08	1.06	1.01	1.00	14	13	13	13	13	13	13	13	13	13
1870	.99	.90	.92	1.07	.94	.98	.96	1.02	1.04	1.06	13	13	13	13	13	13	13	13	13	13
1880	.75	1.07	1.03	.96	1.05	1.06	1.03	.96	.95	1.03	13	13	13	13	13	13	13	13	13	13
1890	1.02	1.05	.97	1.04	1.11	.88	.97	1.02	1.13	.76	13	13	13	13	13	13	13	13	13	13
1900	1.02	1.10	1.02	.99	1.15	1.11	1.13	.86	1.00	.97	13	13	13	13	13	13	13	13	13	13
1910	1.01	.90	.92	.91	1.06	1.05	.98	.98	1.02	.96	13	13	13	13	13	13	13	13	13	13
1920	.86	.99	1.10	.92	.89	1.05	1.11	1.02	1.01	1.02	13	13	13	13	13	13	13	13	13	13
1930	1.07	.97	1.09	.99	.97	.83	.99	.98	.99	1.01	13	13	13	13	13	13	13	13	13	13
1940	1.08	1.03	1.09	.90	1.02	.99	1.03	.88	.98	1.06	13	13	13	13	13	13	13	13	13	13
1950	.99	.97	1.05	1.00	.97	1.02	1.06	.97	1.11	.89	13	13	13	13	13	13	13	13	13	13
1960	.99	.92	1.06	1.07	.88	1.12	.94	1.07	.92	1.06	13	13	13	13	13	13	13	13	13	13
1970	.85	1.00	.99	.96	.96	.94	1.03	1.12	1.12		13	13	13	13	13	13	13	13	13	

FORT VERMILLION SELECT RING WIDTH "B" CHRONOLOGY
YEARS: 1790 1979

	TREE RING INDICES										NUMBER OF RADII									
DATE	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
1790	1.46	1.34	1.22	1.13	1.05	1.01	.98	.98	.96	.91	1	1	1	1	1	1	1	1	1	1
1800	.83	.74	.68	.63	.60	.60	.67	.85	1.12	1.39	1	1	1	1	1	1	1	1	1	1
1810	1.56	1.56	1.44	1.29	1.15	1.03	.90	.79	.73	.75	1	1	1	1	1	1	1	1	1	1
1820	.84	.95	1.04	1.04	.98	.90	.85	.83	.86	.91	1	1	1	1	1	1	1	1	1	1
1830	.94	.93	.88	.81	.74	.72	.75	.84	.94	1.06	1	1	1	1	1	1	1	1	1	1
1840	1.04	1.10	1.15	1.15	1.12	1.07	1.05	1.06	1.09	1.12	2	2	2	2	2	2	2	2	2	2
1850	1.08	1.07	1.06	1.05	1.05	1.04	1.02	.99	.95	.93	3	3	3	3	3	3	3	3	3	3
1860	.94	.97	1.00	.99	.96	.91	.85	.82	.82	.84	3	3	3	3	3	3	3	3	3	3
1870	.92	.96	1.00	1.02	1.04	1.04	1.02	1.00	.99	1.00	4	4	4	4	4	4	4	4	4	4
1880	1.05	1.07	1.07	1.07	1.07	1.09	1.12	1.13	1.11	1.06	5	5	5	5	5	5	5	5	5	5
1890	.99	.94	.91	.90	.89	.88	.87	.87	.89	.91	5	5	5	5	5	5	5	5	5	5
1900	.94	.97	1.01	1.05	1.08	1.08	1.06	1.03	1.01	.98	5	5	5	5	5	5	5	5	5	5
1910	.94	.87	.78	.69	.64	.64	.68	.76	.84	.92	5	5	5	5	5	5	5	5	5	5
1920	1.01	1.10	1.18	1.24	1.29	1.32	1.32	1.27	1.18	1.08	5	5	5	5	5	5	5	5	5	5
1930	1.00	.94	.91	.91	.93	.97	1.00	1.03	1.04	1.02	5	5	5	5	5	5	5	5	5	5
1940	.97	.90	.82	.77	.76	.79	.84	.90	.95	.99	5	5	5	5	5	5	5	5	5	5
1950	1.03	1.06	1.09	1.09	1.09	1.08	1.08	1.09	1.11	1.11	5	5	5	5	5	5	5	5	5	5
1960	1.10	1.07	1.06	1.08	1.10	1.12	1.09	1.04	.97	.91	5	5	5	5	5	5	5	5	5	5
1970	.87	.85	.86	.89	.95	1.01	1.06	1.08	1.09	1.11	5	5	5	5	5	5	5	5	5	5

FORT VERMILLION SELECT RING WIDTH "C" CHRONOLOGY
YEARS: 1790 1979

	TREE RING INDICES										NUMBER OF RADII									
DATE	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
1790	.94	1.33	.63	.89	1.33	.83	.76	1.02	1.30	1.16	1	1	1	1	1	1	1	1	1	1
1800	.68	1.06	1.00	.88	1.06	.96	.64	.65	.73	1.26	1	1	1	1	1	1	1	1	1	1
1810	1.47	1.04	1.03	.71	1.14	1.01	1.21	.67	.71	.99	1	1	1	1	1	1	1	1	1	1
1820	.75	.96	1.45	1.10	.97	.88	.91	.92	.93	1.03	1	1	1	1	1	1	1	1	1	1
1830	1.10	1.09	1.14	.94	.85	.79	.93	.89	1.14	.96	1	1	1	1	1	1	1	1	1	1
1840	.91	1.07	1.02	1.24	.82	1.07	.86	.88	1.07	1.14	2	2	2	2	2	2	2	2	2	2
1850	1.05	.97	.92	1.13	.78	1.16	1.06	.96	1.04	.85	3	3	3	3	3	3	3	3	3	3
1860	.85	1.18	1.02	1.04	1.04	1.00	.97	.91	.87	.95	3	3	3	3	3	3	3	3	3	3
1870	1.02	1.00	1.01	1.05	.95	1.12	.92	1.16	.81	.85	4	4	4	4	4	4	4	4	4	4
1880	1.12	1.01	1.03	1.06	.81	1.07	.89	1.16	1.11	1.00	5	5	5	5	5	5	5	5	5	5
1890	.90	.97	.89	1.15	.87	1.07	1.02	.89	.95	1.04	5	5	5	5	5	5	5	5	5	5
1900	.90	1.02	.93	1.01	1.05	1.09	1.01	.94	.97	.96	5	5	5	5	5	5	5	5	5	5
1910	1.15	1.14	.89	.83	.91	.94	.82	.94	1.11	1.08	5	5	5	5	5	5	5	5	5	5
1920	.79	1.03	1.15	1.00	.95	1.03	1.05	1.14	1.03	.00	5	5	5	5	5	5	5	5	5	5
1930	1.00	1.01	.94	.95	.86	1.13	.94	1.06	1.01	1.07	5	5	5	5	5	5	5	5	5	5
1940	1.08	1.03	.90	.85	.92	.94	.97	1.07	.95	1.05	5	5	5	5	5	5	5	5	5	5
1950	1.02	.93	.99	1.22	.88	.94	1.04	.92	1.03	1.08	5	5	5	5	5	5	5	5	5	5
1960	1.06	.96	.90	.93	1.02	1.16	1.05	.90	.96	1.00	5	5	5	5	5	5	5	5	5	5
1970	.92	1.04	.86	.93	.99	1.06	1.08	1.00	1.01	.90	5	5	5	5	5	5	5	5	5	5

FORT VERMILLION SELECT RING WIDTH "B&C" CHRONOLOGY
YEARS: 1790 1979

	TREE RING INDICES										NUMBER OF RADII									
DATE	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
1790	1.37	1.79	.77	1.00	1.40	.83	.75	1.00	1.25	1.05	1	1	1	1	1	1	1	1	1	1
1800	.56	.79	.68	.56	.64	.58	.43	.55	.82	1.75	1	1	1	1	1	1	1	1	1	1
1810	2.29	1.63	1.48	.91	1.31	1.04	1.09	.53	.52	.74	1	1	1	1	1	1	1	1	1	1
1820	.63	.92	1.50	1.15	.95	.79	.77	.77	.80	.93	1	1	1	1	1	1	1	1	1	1
1830	1.03	1.02	1.01	.76	.63	.57	.70	.74	1.07	1.02	1	1	1	1	1	1	1	1	1	1
1840	.95	1.14	1.20	1.44	.95	1.12	.89	.94	1.15	1.20	2	2	2	2	2	2	2	2	2	2
1850	1.12	1.04	.98	1.20	.82	1.22	1.09	.94	.98	.79	3	3	3	3	3	3	3	3	3	3
1860	.80	1.15	1.02	1.03	1.00	.91	.85	.75	.72	.81	3	3	3	3	3	3	3	3	3	3
1870	.94	.97	1.00	1.07	.99	1.17	.94	1.16	.81	.85	4	4	4	4	4	4	4	4	4	4
1880	1.16	1.08	1.10	1.14	.88	1.18	1.00	1.32	1.23	1.05	5	5	5	5	5	5	5	5	5	5
1890	.90	.91	.81	1.05	.77	.95	.90	.79	.84	.96	5	5	5	5	5	5	5	5	5	5
1900	.92	1.00	.95	1.05	1.13	1.17	1.09	.97	.99	.94	5	5	5	5	5	5	5	5	5	5
1910	1.09	.99	.69	.59	.58	.60	.56	.72	.95	1.00	5	5	5	5	5	5	5	5	5	5
1920	.80	1.12	1.36	1.24	1.20	1.37	1.41	1.46	1.22	.87	5	5	5	5	5	5	5	5	5	5
1930	1.01	.95	.85	.86	.81	1.09	.94	1.08	1.05	1.10	5	5	5	5	5	5	5	5	5	5
1940	1.06	.92	.73	.66	.72	.73	.82	.98	.89	1.05	5	5	5	5	5	5	5	5	5	5
1950	1.04	.99	1.08	1.34	.96	1.01	1.13	1.00	1.13	1.19	5	5	5	5	5	5	5	5	5	5
1960	1.16	1.04	.96	1.01	1.11	1.30	1.15	1.02	.93	.91	5	5	5	5	5	5	5	5	5	5
1970	.80	.89	.74	.83	.94	1.08	1.15	1.09	1.11	1.00	5	5	5	5	5	5	5	5	5	5

FORT VERMILLION SELECT MAXIMUM DENSITY "B" CHRONOLOGY
YEARS: 1790 1979

	TREE RING INDICES										NUMBER OF RADII									
DATE	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
1790	1.12	1.09	1.05	1.02	1.01	1.00	1.01	1.01	1.00	.98	1	1	1	1	1	1	1	1	1	1
1800	.94	.98	.87	.85	.86	.89	.94	1.00	1.07	1.10	1	1	1	1	1	1	1	1	1	1
1810	1.10	1.08	1.06	1.05	1.03	1.00	.96	.92	.90	.91	1	1	1	1	1	1	1	1	1	1
1820	.94	.98	1.02	1.04	1.04	1.03	1.01	1.01	1.02	1.03	1	1	1	1	1	1	1	1	1	1
1830	1.04	1.03	1.00	.97	.96	.96	.97	.98	1.00	1.01	1	1	1	1	1	1	1	1	1	1
1840	1.01	1.02	1.03	1.04	1.03	1.02	1.01	1.00	.99	.99	2	2	2	2	2	2	2	2	2	2
1850	.98	1.00	1.01	1.01	1.01	1.01	1.02	1.01	1.01	1.00	3	3	3	3	3	3	3	3	3	3
1860	1.00	1.01	1.01	1.01	1.01	1.01	1.01	1.00	1.01	1.01	3	3	3	3	3	3	3	3	3	3
1870	1.01	1.01	1.01	1.00	1.00	.99	1.00	1.01	1.01	1.01	4	4	4	4	4	4	4	4	4	4
1880	.99	.99	.99	.99	.99	.99	.99	1.00	1.00	1.00	5	5	5	5	5	5	5	5	5	5
1890	1.00	.99	.99	.99	1.00	1.01	1.01	1.01	1.01	1.00	5	5	5	5	5	5	5	5	5	5
1900	.99	1.00	1.01	1.01	1.02	1.02	1.01	1.00	.99	.99	5	5	5	5	5	5	5	5	5	5
1910	.99	.98	.97	.95	.94	.93	.93	.93	.94	.96	5	5	5	5	5	5	5	5	5	5
1920	.98	1.01	1.03	1.05	1.06	1.07	1.07	1.06	1.05	1.04	5	5	5	5	5	5	5	5	5	5
1930	1.03	1.02	1.01	1.00	1.00	1.01	1.02	1.03	1.04	1.03	5	5	5	5	5	5	5	5	5	5
1940	1.02	1.00	.98	.96	.96	.96	.96	.96	.97	.98	5	5	5	5	5	5	5	5	5	5
1950	.99	1.00	1.01	1.01	1.00	.99	.99	1.00	1.01	1.02	5	5	5	5	5	5	5	5	5	5
1960	1.02	1.02	1.02	1.02	1.02	1.02	1.00	.98	.97	.97	5	5	5	5	5	5	5	5	5	5
1970	.97	.97	.98	.99	1.00	1.01	1.02	1.02	1.02	1.02	5	5	5	5	5	5	5	5	5	5

FORT VERMILLION SELECT MAXIMUM DENSITY "C" CHRONOLOGY
YEARS: 1790 1979

	TREE RING INDICES										NUMBER OF RADII									
DATE	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
1790	.99	1.14	.87	.92	1.10	.99	.88	1.09	1.04	1.06	1	1	1	1	1	1	1	1	1	1
1800	1.00	.91	1.05	.90	.97	.99	.98	.86	1.16	1.10	1	1	1	1	1	1	1	1	1	1
1810	1.00	.99	1.00	.89	1.10	1.08	.99	.97	.86	1.02	1	1	1	1	1	1	1	1	1	1
1820	.96	.93	1.15	1.00	1.05	.97	1.00	.93	1.01	.96	1	1	1	1	1	1	1	1	1	1
1830	1.13	1.01	.99	.96	.94	1.06	.92	1.00	1.10	.93	1	1	1	1	1	1	1	1	1	1
1840	1.01	.98	1.02	1.03	1.01	.99	1.03	.96	1.00	1.00	2	2	2	2	2	2	2	2	2	2
1850	.97	.98	1.04	1.05	1.01	.88	1.08	1.02	1.01	.94	3	3	3	3	3	3	3	3	3	3
1860	1.02	.98	1.03	.99	1.01	1.01	1.00	.97	.97	1.07	3	3	3	3	3	3	3	3	3	3
1870	1.00	.97	1.01	1.01	.98	1.02	.96	1.00	1.02	1.07	4	4	4	4	4	4	4	4	4	4
1880	.94	1.01	1.02	1.00	.97	1.00	1.02	1.02	.97	1.00	5	5	5	5	5	5	5	5	5	5
1890	1.02	1.01	.97	1.00	.99	1.01	.98	1.03	1.06	.91	5	5	5	5	5	5	5	5	5	5
1900	1.02	1.00	.97	.99	1.04	1.02	1.03	.93	1.02	.98	5	5	5	5	5	5	5	5	5	5
1910	1.04	1.00	1.03	.91	1.01	1.07	.93	.96	1.02	.99	5	5	5	5	5	5	5	5	5	5
1920	.99	1.02	1.01	1.00	1.02	1.00	1.02	1.04	.94	.99	5	5	5	5	5	5	5	5	5	5
1930	1.03	1.04	.95	.99	.98	.98	.99	1.05	.99	1.02	5	5	5	5	5	5	5	5	5	5
1940	1.07	.94	.98	1.00	.98	1.01	1.02	.95	1.01	1.03	5	5	5	5	5	5	5	5	5	5
1950	.96	.99	1.03	1.00	.94	.96	1.02	.95	1.04	.99	5	5	5	5	5	5	5	5	5	5
1960	1.02	1.01	.96	1.01	1.00	1.05	.98	1.01	.97	.99	5	5	5	5	5	5	5	5	5	5
1970	.99	1.06	.93	1.02	.96	1.03	1.04	.97	.97	1.02	5	5	5	5	5	5	5	5	5	5

FORT VERMILLION SELECT MAXIMUM DENSITY "B&C" CHRONOLOGY
YEARS: 1790 1979

	TREE RING INDICES										NUMBER OF RADII									
DATE	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
1790	1.11	1.24	.91	.94	1.11	.99	.88	1.10	1.04	1.04	1	1	1	1	1	1	1	1	1	1
1800	.94	.82	.91	.77	.83	.88	.92	.86	1.24	1.21	1	1	1	1	1	1	1	1	1	1
1810	1.11	1.07	1.06	.93	1.13	1.09	.95	.89	.77	.92	1	1	1	1	1	1	1	1	1	1
1820	.90	.92	1.18	1.05	1.09	.99	1.01	.94	1.03	.99	1	1	1	1	1	1	1	1	1	1
1830	1.17	1.04	.99	.94	.90	1.01	.89	.98	1.10	.94	1	1	1	1	1	1	1	1	1	1
1840	1.02	1.00	1.05	1.07	1.04	1.00	1.03	.95	.99	.99	2	2	2	2	2	2	2	2	2	2
1850	.95	.97	1.05	1.06	1.02	.89	1.10	1.03	1.02	.94	3	3	3	3	3	3	3	3	3	3
1860	1.02	.99	1.05	1.01	1.02	1.02	1.01	.98	.97	1.08	3	3	3	3	3	3	3	3	3	3
1870	1.01	.98	1.02	1.02	.98	1.02	.95	1.00	1.04	1.08	4	4	4	4	4	4	4	4	4	4
1880	.93	1.00	1.01	.99	.96	1.00	1.01	1.01	.97	1.00	5	5	5	5	5	5	5	5	5	5
1890	1.02	1.00	.96	.99	.99	1.02	.99	1.05	1.07	.91	5	5	5	5	5	5	5	5	5	5
1900	1.01	1.00	.98	1.00	1.06	1.04	1.04	.93	1.01	.97	5	5	5	5	5	5	5	5	5	5
1910	1.03	.98	1.00	.88	.96	1.00	.86	.98	.96	.95	5	5	5	5	5	5	5	5	5	5
1920	.97	1.02	1.03	1.05	1.08	1.07	1.09	1.10	.99	1.03	5	5	5	5	5	5	5	5	5	5
1930	1.07	1.07	.96	.99	.98	.99	1.01	1.08	1.02	1.05	5	5	5	5	5	5	5	5	5	5
1940	1.09	.94	.96	.96	.95	.96	.98	.92	.98	1.00	5	5	5	5	5	5	5	5	5	5
1950	.95	1.00	1.04	1.09	.95	.95	1.01	.95	1.05	1.00	5	5	5	5	5	5	5	5	5	5
1960	1.04	1.03	.98	1.04	1.03	1.07	.98	.99	.94	.96	5	5	5	5	5	5	5	5	5	5
1970	.96	1.03	.91	1.01	.96	1.05	1.07	1.00	1.00	1.04	5	5	5	5	5	5	5	5	5	5

FORT RESOLUTION RING WIDTH "B" CHRONOLOGY
YEARS: 1748 1979

	TREE RING INDICES										NUMBER OF RADII									
DATE	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
1740									.81	.99									2	2
1750	1.18	1.32	1.36	1.29	1.14	.99	.85	.75	.73	.75	2	2	2	2	2	2	2	2	2	2
1760	.80	.85	.86	.84	.83	.84	.87	.91	.95	.89	2	2	2	2	2	2	2	2	2	3
1770	.88	.91	.94	.98	1.01	1.04	1.03	1.01	.98	.96	4	4	4	4	4	4	4	4	4	4
1780	.96	.96	.89	.88	.88	.89	.93	.97	1.02	1.05	4	4	5	5	5	5	5	5	5	5
1790	1.07	1.05	1.03	1.00	.99	.98	.99	1.00	1.02	1.04	5	6	6	6	6	7	8	9	9	9
1800	1.02	1.06	1.10	1.13	1.15	1.15	1.12	1.08	1.04	.99	10	10	10	11	11	11	11	11	11	11
1810	.94	.91	.90	.91	.92	.93	.94	.94	.95	.96	11	11	11	11	11	11	11	11	11	11
1820	.98	1.00	1.01	1.01	1.00	1.00	.99	.98	.97	.96	11	12	12	12	12	12	12	12	12	12
1830	.94	.96	.98	.98	.97	.94	.91	.89	.89	.90	14	14	14	14	14	14	14	14	14	14
1840	.94	.98	1.03	1.07	1.09	1.11	1.12	1.10	1.08	1.05	14	14	14	14	14	14	14	14	14	14
1850	1.02	1.01	1.00	1.01	1.02	1.03	1.04	1.03	1.02	1.00	14	14	14	14	14	14	14	14	14	14
1860	.99	.99	.98	.95	.92	.89	.88	.88	.89	.91	14	14	14	14	14	14	14	14	14	14
1870	.93	.97	1.01	1.03	1.03	1.01	.97	.93	.89	.88	[illegible]	14	14	14	14	14	14	14	14	14
1880	.91	.98	1.05	1.09	1.09	1.06	1.02	.99	.96	.96	14	14	14	14	14	14	14	14	14	14
1890	.96	.97	.95	.97	.98	1.00	1.01	1.04	1.07	1.10	14	14	16	16	16	16	16	16	16	16
1900	1.12	1.12	1.11	1.08	1.05	1.02	1.00	.99	.99	1.01	16	16	16	16	16	16	16	16	16	16
1910	1.02	1.01	.97	.92	.86	.81	.78	.77	.79	.82	16	16	16	16	16	16	16	16	16	16
1920	.87	.94	1.01	1.07	1.12	1.14	1.13	1.10	1.07	1.05	16	16	16	16	16	16	16	16	16	16
1930	1.06	1.10	1.14	1.18	1.20	1.18	1.12	1.04	.98	.93	16	16	16	16	16	16	16	16	16	16
1940	.90	.86	.83	.79	.75	.72	.72	.76	.81	.86	16	16	16	16	16	16	16	16	16	16
1950	.89	.89	.89	.89	.88	.89	.90	.92	.95	.97	16	16	16	16	16	16	16	16	16	16
1960	1.00	1.03	1.07	1.08	1.07	1.03	.99	.98	1.00	1.02	16	16	16	16	16	16	16	16	16	16
1970	1.02	.99	.97	.97	1.00	1.03	1.04	1.01	.96	.91	16	16	16	16	16	16	16	16	16	16

FORT RESOLUTION RING WIDTH "C" CHRONOLOGY
YEARS: 1748 1979

	TREE RING INDICES										NUMBER OF RADII									
DATE	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
1740									.83	.95									2	2
1750	.82	1.32	1.58	.63	1.13	1.07	.87	.83	.76	.97	2	2	2	2	2	2	2	2	2	2
1760	.98	1.19	1.17	.83	.93	1.00	.92	1.05	1.04	1.09	2	2	2	2	2	2	2	2	2	3
1770	.99	.93	1.03	.98	.98	1.03	1.16	1.03	.80	1.05	4	4	4	4	4	4	4	4	4	4
1780	.96	1.03	1.11	.98	1.02	.74	1.09	1.08	.97	.99	4	4	5	5	5	5	5	5	5	5
1790	.99	1.13	1.04	.80	1.00	1.04	1.02	.92	1.01	1.02	5	6	6	6	6	7	8	9	9	9
1800	1.00	.92	1.10	.93	1.10	1.03	.97	1.07	.97	.98	10	10	10	11	11	11	11	11	11	11
1810	1.00	.97	.91	1.05	.92	1.13	.94	.99	1.02	.93	11	11	11	11	11	11	11	11	11	11
1820	1.03	.97	1.10	.93	1.05	.98	1.01	.85	1.27	.98	11	12	12	12	12	12	12	12	12	12
1830	.78	.98	1.12	1.06	.99	.96	1.00	.98	.97	.91	14	14	14	14	14	14	14	14	14	14
1840	1.00	.95	1.08	1.06	.91	1.07	1.02	.99	1.05	1.04	14	14	14	14	14	14	14	14	14	14
1850	.87	.97	1.00	1.07	.98	1.02	1.03	1.08	.94	.95	14	14	14	14	14	14	14	14	14	14
1860	1.03	1.02	.99	1.06	1.07	.83	1.00	.93	1.21	.81	14	14	14	14	14	14	14	14	14	14
1870	.93	1.06	1.05	.99	1.09	1.05	.81	1.26	.93	.74	14	14	14	14	14	14	14	14	14	14
1880	.91	1.00	1.12	1.03	1.08	1.04	.87	1.02	1.03	.86	14	14	14	14	14	14	14	14	14	14
1890	1.06	1.01	.95	1.05	.95	1.02	1.00	1.00	.98	1.07	14	14	16	16	16	16	16	16	16	16
1900	1.06	1.01	.99	1.02	.98	1.03	.98	.89	1.05	.98	16	16	16	16	16	16	16	16	16	16
1910	1.01	1.09	1.05	.94	1.07	.89	.93	.97	.97	1.08	16	16	16	16	16	16	16	16	16	16
1920	.75	1.08	1.07	1.01	.94	1.14	1.04	1.08	.82	.97	16	16	16	16	16	16	16	16	16	16
1930	1.00	1.00	.97	.97	1.08	1.17	1.05	.82	.90	1.10	16	16	16	16	16	16	16	16	16	16
1940	1.05	.88	1.04	1.06	1.03	.87	.82	.91	1.10	1.09	16	16	16	16	16	16	16	16	16	16
1950	.99	1.06	.90	1.15	.84	1.00	1.04	.95	.97	1.03	16	16	16	16	16	16	16	16	16	16
1960	1.07	.87	.96	1.21	.99	1.10	.86	.79	.99	1.24	16	16	16	16	16	16	16	16	16	16
1970	1.00	.97	1.00	.79	.99	1.14	1.06	1.09	1.00	.77	16	16	16	16	16	16	16	16	16	16

FORT RESOLUTION RING WIDTH "B&C" CHRONOLOGY
YEARS: 1748 1979

	TREE RING INDICES										NUMBER OF RADII									
DATE	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
1740									.67	.94									2	2
1750	.96	1.73	2.04	.81	1.30	1.06	.74	.63	.56	.72	2	2	2	2	2	2	2	2	2	2
1760	.78	1.00	1.01	.70	.77	.84	.80	.95	.99	.98	2	2	2	2	2	2	2	2	2	3
1770	.88	.85	.97	.97	1.00	1.06	1.20	1.05	.79	1.01	4	4	4	4	4	4	4	4	4	4
1780	.92	.99	.99	.86	.89	.66	1.00	1.05	.99	1.04	4	4	5	5	5	5	5	5	5	5
1790	1.06	1.19	1.07	.80	.99	1.03	1.01	.92	1.03	1.06	5	6	6	6	6	7	8	9	9	9
1800	1.04	.97	1.21	1.05	1.26	1.18	1.10	1.16	1.00	.98	10	10	10	11	11	11	11	11	11	11
1810	.95	.89	.82	.95	.84	1.05	.88	.93	.97	.89	11	11	11	11	11	11	11	11	11	11
1820	1.01	.97	1.12	.94	1.06	.98	1.00	.83	1.23	.94	11	12	12	12	12	12	12	12	12	12
1830	.73	.94	1.09	1.05	.97	.93	.91	.87	.86	.83	14	14	14	14	14	14	14	14	14	14
1840	.93	.94	1.11	1.13	1.00	1.19	1.14	1.10	1.13	1.09	14	14	14	14	14	14	14	14	14	14
1850	.89	.98	1.02	1.09	.92	1.06	1.07	1.12	.95	.95	14	14	14	14	14	14	14	14	14	14
1860	1.02	1.01	.97	1.01	.98	.74	.88	.82	1.08	.74	14	14	14	14	14	14	14	14	14	14
1870	.87	1.04	1.06	1.02	1.13	1.05	.78	1.18	.83	.66	14	14	14	14	14	14	14	14	14	14
1880	.84	.99	1.18	1.13	1.19	1.11	.89	1.01	.99	.82	14	14	14	14	14	14	14	14	14	14
1890	1.03	.98	.91	1.02	.93	1.02	1.01	1.04	.97	1.18	14	14	16	16	16	16	16	16	16	16
1900	1.19	1.14	1.11	1.10	1.03	1.07	.98	.88	1.05	.99	16	16	16	16	16	16	16	16	16	16
1910	1.02	1.09	1.03	.87	.92	.73	.73	.75	.76	.88	16	16	16	16	16	16	16	16	16	16
1920	.65	1.01	1.08	1.08	1.05	1.30	1.18	1.19	.87	1.03	16	16	16	16	16	16	16	16	16	16
1930	1.07	1.10	1.11	1.14	1.29	1.38	1.18	.86	.88	1.03	16	16	16	16	16	16	16	16	16	16
1940	.95	.75	.86	.84	.77	.63	.60	.70	.89	.94	16	16	16	16	16	16	16	16	16	16
1950	.88	.94	.81	1.02	.74	.89	.95	.88	.92	1.00	16	16	16	16	16	16	16	16	16	16
1960	1.07	.90	1.03	1.30	1.07	1.14	.85	.78	.98	1.28	16	16	16	16	16	16	16	16	16	16
1970	1.02	.96	.97	.77	.99	1.18	1.10	1.10	.96	.70	16	16	16	16	16	16	16	16	16	16

FORT RESOLUTION MAXIMUM DENSITY "B" CHRONOLOGY
YEARS: 1748 1979

	TREE RING INDICES										NUMBER OF RADII									
DATE	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
1740									1.00	1.00									2	2
1750	1.00	1.00	1.00	1.00	1.00	1.01	1.00	1.01	1.00	1.01	2	2	2	2	2	2	2	2	2	2
1760	1.01	1.02	1.01	1.01	1.00	1.00	1.00	1.00	1.00	1.00	2	2	2	2	2	2	2	2	2	3
1770	.99	1.01	1.02	1.03	1.02	1.01	.99	.98	.98	.99	4	4	4	4	4	4	4	4	4	4
1780	1.00	1.01	1.01	1.00	.99	.98	.97	.98	.99	1.01	4	4	5	5	5	5	5	5	5	5
1790	1.02	1.02	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	5	6	6	6	6	7	8	9	9	9
1800	1.00	.99	1.00	1.00	1.01	1.02	1.03	1.03	1.03	1.02	10	10	10	11	11	11	11	11	11	11
1810	1.00	.99	.99	.99	1.01	1.01	1.01	1.00	.99	.99	11	11	11	11	11	11	11	11	11	11
1820	1.00	1.01	1.02	1.03	1.04	1.04	1.04	1.04	1.02	1.01	11	12	12	12	12	12	12	12	12	12
1830	1.00	.98	.96	.96	.94	.93	.93	.94	.97	.99	14	14	14	14	14	14	14	14	14	14
1840	1.01	1.02	1.03	1.03	1.03	1.03	1.02	1.00	.98	.97	14	14	14	14	14	14	14	14	14	14
1850	.98	1.00	1.03	1.04	1.04	1.04	1.03	1.02	1.01	1.01	14	14	14	14	14	14	14	14	14	14
1860	1.01	1.01	1.01	.99	.98	.98	.99	1.00	1.01	1.01	14	14	14	14	14	14	14	14	14	14
1870	1.00	1.00	.99	.99	.98	.97	.97	.98	.99	1.00	14	14	14	14	14	14	14	14	14	14
1880	1.02	1.03	1.04	1.03	1.01	.99	.97	.96	.95	.96	14	14	14	14	14	14	14	14	14	14
1890	.96	.97	.95	.97	.99	1.01	1.02	1.03	1.04	1.05	14	14	16	16	16	16	16	16	16	16
1900	1.04	1.04	1.03	1.02	1.02	1.02	1.02	1.02	1.02	1.02	16	16	16	16	16	16	16	16	16	16
1910	1.02	1.02	1.02	1.01	.99	.97	.95	.94	.94	.94	16	16	16	16	16	16	16	16	16	16
1920	.95	.96	.97	.99	1.01	1.02	1.03	1.03	1.03	1.05	16	16	16	16	16	16	16	16	16	16
1930	1.07	1.08	1.08	1.07	1.05	1.02	.99	.97	.96	.96	16	16	16	16	16	16	16	16	16	16
1940	.96	.96	.97	.97	.97	.96	.96	.98	1.00	1.02	16	16	16	16	16	16	16	16	16	16
1950	1.02	1.02	1.00	.98	.95	.94	.94	.95	.96	.97	16	16	16	16	16	16	16	16	16	16
1960	.98	.99	1.00	1.01	1.01	1.00	.99	.99	.99	1.00	16	16	16	16	16	16	16	16	16	16
1970	1.01	1.01	1.01	1.01	1.02	1.03	1.03	1.02	1.00	.99	16	16	16	16	16	16	16	16	16	16

FORT RESOLUTION MAXIMUM DENSITY "C" CHRONOLOGY
YEARS: 1748 1979

TREE RING INDICES

DATE	0	1	2	3	4	5	6	7	8	9
1740									.98	1.01
1750	1.07	.94	.96	1.05	1.00	1.01	.98	1.03	.98	.99
1760	.99	1.04	1.06	.89	1.05	1.00	1.01	.95	1.06	1.01
1770	.94	1.06	.97	1.01	1.07	.98	.98	1.02	.91	1.00
1780	1.04	1.00	1.01	1.02	1.00	.98	.94	1.04	.97	.99
1790	1.04	1.02	1.01	.99	.97	.98	1.04	.99	.98	1.01
1800	1.03	1.03	.87	1.02	1.06	1.03	.91	1.06	1.03	1.00
1810	1.00	.96	.99	.95	1.02	1.08	1.02	.92	1.06	.91
1820	1.05	.96	1.07	.92	1.03	1.02	1.04	.92	1.08	1.03
1830	.96	1.03	.93	1.02	1.04	1.09	.75	1.06	1.03	.99
1840	1.03	.99	1.02	1.00	.97	1.01	1.07	1.04	.94	.88
1850	1.04	.97	1.05	1.04	.99	.95	1.03	1.06	.95	.94
1860	1.01	1.04	1.01	1.03	.98	.88	1.02	1.03	1.06	.99
1870	.97	1.01	.97	1.06	.98	1.00	.93	1.05	1.02	.97
1880	.93	1.05	1.05	1.06	.91	1.03	1.01	.98	.91	1.06
1890	1.02	.99	.96	1.00	1.00	1.03	.99	.98	1.06	.93
1900	1.10	.98	.99	.97	.99	1.06	1.01	.88	1.09	1.00
1910	.97	1.04	1.01	.98	.98	1.10	.94	.93	.97	1.08
1920	.96	.99	1.01	.97	.95	1.10	1.02	.99	.87	1.06
1930	1.02	1.04	.98	1.02	1.03	1.01	.97	.97	.93	1.06
1940	1.07	.85	1.05	1.04	1.05	.94	.96	.96	1.03	1.07
1950	.96	1.03	1.02	1.08	.86	1.01	.97	.99	1.08	.92
1960	1.07	.89	1.04	1.07	.98	1.04	.96	.96	.99	1.05
1970	.96	1.05	.98	.98	.97	1.05	1.01	1.05	.97	.95

NUMBER OF RADII

0	1	2	3	4	5	6	7	8	9
								2	2
2	2	2	2	2	2	2	2	2	2
2	2	2	2	2	2	2	2	2	3
4	4	4	4	4	4	4	4	4	4
4	4	5	5	5	5	5	5	5	5
5	6	6	6	6	7	8	9	9	9
10	10	10	11	11	11	11	11	11	11
11	11	11	11	11	11	11	11	11	11
11	12	12	12	12	12	12	12	12	12
14	14	14	14	14	14	14	14	14	14
14	14	14	14	14	14	14	14	14	14
14	14	14	14	14	14	14	14	14	14
14	14	14	14	14	14	14	14	14	14
14	14	14	14	14	14	14	14	14	14
14	14	14	14	14	14	14	14	14	14
14	14	16	16	16	16	16	16	16	16
16	16	16	16	16	16	16	16	16	16
16	16	16	16	16	16	16	16	16	16
16	16	16	16	16	16	16	16	16	16
16	16	16	16	16	16	16	16	16	16
16	16	16	16	16	16	16	16	16	16
16	16	16	16	16	16	16	16	16	16
16	16	16	16	16	16	16	16	16	16

FORT RESOLUTION MAXIMUM DENSITY "B&C" CHRONOLOGY
YEARS: 1748 1979

TREE RING INDICES

DATE	0	1	2	3	4	5	6	7	8	9
1740									.98	1.01
1750	1.06	.94	.95	1.05	1.00	1.02	.98	1.04	.98	1.00
1760	1.00	1.06	1.07	.89	1.05	1.00	1.00	.94	1.05	1.00
1770	.93	1.06	.99	1.04	1.10	.99	.98	1.00	.89	.99
1780	1.04	1.01	1.02	1.02	.99	.96	.91	1.02	.97	1.00
1790	1.06	1.04	1.02	1.00	.98	.99	1.05	1.00	1.00	1.02
1800	1.03	1.02	.86	1.02	1.07	1.06	.93	1.09	1.06	1.02
1810	1.00	.95	.98	.94	1.03	1.10	1.03	.92	1.05	.90
1820	1.06	.97	1.09	.95	1.07	1.06	1.08	.95	1.10	1.03
1830	.95	1.00	.90	.98	.98	1.02	.69	1.00	.99	.98
1840	1.05	1.02	1.05	1.03	1.00	1.04	1.09	1.04	.92	.86
1850	1.01	.98	1.08	1.08	1.03	.98	1.06	1.08	.97	.95
1860	1.02	1.05	1.02	1.02	.96	.86	1.01	1.04	1.07	1.00
1870	.98	1.01	.97	1.04	.96	.97	.90	1.03	1.01	.97
1880	.95	1.08	1.10	1.09	.92	1.02	.98	.94	.87	1.01
1890	.98	.95	.92	.97	.99	1.03	1.01	1.02	1.10	.97
1900	1.15	1.01	1.01	.99	1.00	1.07	1.03	.90	1.11	1.02
1910	.99	1.07	1.03	.99	.98	1.08	.90	.87	.91	1.02
1920	.92	.96	.98	.96	.96	1.12	1.05	1.02	.90	1.11
1930	1.08	1.12	1.07	1.09	1.09	1.04	.97	.94	.89	1.01
1940	1.02	.82	1.01	1.01	1.02	.91	.92	.94	1.03	1.08
1950	.98	1.05	1.02	1.06	.82	.95	.92	.95	1.04	.89
1960	1.05	.88	1.04	1.08	.99	1.04	.95	.95	.99	1.05
1970	.97	1.05	.99	.99	.99	1.07	1.04	1.07	.97	.95

NUMBER OF RADII

0	1	2	3	4	5	6	7	8	9
								2	2
2	2	2	2	2	2	2	2	2	2
2	2	2	2	2	2	2	2	2	3
4	4	4	4	4	4	4	4	4	4
4	4	5	5	5	5	5	5	5	5
5	6	6	6	6	7	8	9	9	9
10	10	10	11	11	11	11	11	11	11
11	11	11	11	11	11	11	11	11	11
11	12	12	12	12	12	12	12	12	12
14	14	14	14	14	14	14	14	14	14
14	14	14	14	14	14	14	14	14	14
14	14	14	14	14	14	14	14	14	14
14	14	14	14	14	14	14	14	14	14
14	14	14	14	14	14	14	14	14	14
14	14	14	14	14	14	14	14	14	14
14	14	16	16	16	16	16	16	16	16
16	16	16	16	16	16	16	16	16	16
16	16	16	16	16	16	16	16	16	16
16	16	16	16	16	16	16	16	16	16
16	16	16	16	16	16	16	16	16	16
16	16	16	16	16	16	16	16	16	16
16	16	16	16	16	16	16	16	16	16
16	16	16	16	16	16	16	16	16	16

PRELUDE LAKE SELECT RING WIDTH "B" CHRONOLOGY
YEARS: 1700 1979

	TREE RING INDICES										NUMBER OF RADII									
DATE	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
1700	1.06	1.15	1.24	1.26	1.18	1.06	.94	.86	.82	.79	1	1	1	1	1	1	1	1	1	1
1710	.76	.74	.74	.76	.81	.88	.98	1.08	1.13	1.12	1	1	1	1	1	1	1	1	1	1
1720	1.05	.93	.82	.73	.67	.63	.62	.64	.66	.68	1	1	1	1	1	1	1	1	1	1
1730	.61	.70	.79	.86	.93	1.01	1.12	1.21	1.26	1.26	3	3	3	3	3	3	3	3	3	3
1740	1.23	1.20	1.17	1.29	1.15	1.00	.87	.79	.79	.82	3	3	3	4	4	4	4	5	5	5
1750	.85	.88	.94	1.01	1.08	1.13	1.14	1.13	1.11	1.10	5	5	5	5	5	5	5	5	5	5
1760	1.07	1.00	.92	.83	.77	.77	.82	.89	.95	.99	5	5	5	5	5	5	5	5	5	5
1770	1.00	1.01	1.00	1.00	.97	.98	1.01	1.04	1.07	1.09	5	5	5	5	6	6	6	6	6	6
1780	1.11	1.11	1.08	1.14	1.08	1.04	1.03	1.05	1.10	1.15	6	6	6	7	7	7	7	7	7	7
1790	1.17	1.11	.99	.85	.75	.69	.67	.65	.64	.62	7	7	7	7	7	7	7	7	7	7
1800	.60	.58	.57	.60	.67	.79	.95	1.12	1.28	1.40	7	7	7	7	7	7	7	7	7	7
1810	1.39	1.42	1.42	1.38	1.34	1.29	1.23	1.16	1.06	.95	8	8	8	8	8	8	8	8	8	8
1820	.87	.81	.79	.80	.82	.86	.89	.91	.93	.93	8	8	8	8	8	8	8	8	8	8
1830	.91	.89	.87	.84	.82	.80	.79	.80	.84	.92	8	8	8	8	8	8	8	8	8	8
1840	1.01	1.08	1.12	1.13	1.11	1.07	1.01	.95	.91	.89	8	8	8	8	8	8	8	8	8	8
1850	.90	.93	.96	.99	1.00	1.00	1.02	1.06	1.14	1.23	8	8	8	8	8	8	8	8	8	8
1860	1.29	1.31	1.25	1.15	1.04	.99	1.00	1.02	1.04	1.05	8	8	8	8	8	8	10	10	10	10
1870	1.06	1.06	1.03	.97	.88	.80	.75	.73	.75	.79	10	10	10	10	10	10	10	10	10	10
1880	.85	.93	1.02	1.07	1.08	1.07	1.07	1.09	1.13	1.17	10	10	10	10	10	10	10	10	10	10
1890	1.20	1.22	1.20	1.15	1.07	.99	.92	.89	.91	.96	10	10	10	10	10	10	10	10	10	10
1900	1.01	1.03	1.02	.98	.94	.93	.93	.96	1.00	1.04	10	10	10	10	10	10	10	10	10	10
1910	1.08	1.08	1.05	1.00	.94	.88	.84	.84	.86	.89	10	10	10	10	10	10	10	10	10	10
1920	.93	.97	1.00	1.02	1.02	.99	.94	.90	.87	.87	10	10	10	10	10	10	10	10	10	10
1930	.88	.92	.98	1.05	1.10	1.11	1.08	1.01	.92	.86	10	10	10	10	10	10	10	10	10	10
1940	.83	.85	.88	.91	.95	.99	1.03	1.06	1.08	1.07	10	10	10	10	10	10	10	10	10	10
1950	1.05	1.04	1.03	1.04	1.06	1.06	1.05	1.03	1.02	1.02	10	10	10	10	10	10	10	10	10	10
1960	1.01	1.00	.99	1.00	1.02	1.02	.99	.95	.93	.95	10	10	10	10	10	10	10	10	10	10
1970	.98	.99	.98	.96	.95	.96	1.00	1.07	1.15	1.24	10	10	10	10	10	10	10	10	10	8

PRELUDE LAKE SELECT RING WIDTH "C" CHRONOLOGY
YEARS: 1700 1979

	TREE RING INDICES										NUMBER OF RADII									
DATE	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
1700	.76	.80	1.26	1.38	.96	.84	.85	1.14	.72	1.25	1	1	1	1	1	1	1	1	1	1
1710	.97	.85	.99	.92	1.01	.93	.85	1.15	1.19	.99	1	1	1	1	1	1	1	1	1	1
1720	1.20	.97	.79	.89	1.17	.84	.92	.80	1.30	.91	1	1	1	1	1	1	1	1	1	1
1730	.92	.93	1.29	.91	.84	1.03	.93	1.06	1.13	1.10	3	3	3	3	3	3	3	3	3	3
1740	.84	.94	1.09	1.07	1.10	.88	.88	.76	.98	1.07	3	3	3	4	4	4	4	5	5	5
1750	.98	1.07	.77	.87	1.23	1.08	.93	1.01	.96	.97	5	5	5	5	5	5	5	5	5	5
1760	1.12	1.06	.99	.93	.88	.75	1.01	1.02	1.20	.83	5	5	5	5	5	5	5	5	5	5
1770	1.04	.97	1.06	1.02	1.04	.78	1.05	1.18	.85	.97	5	5	5	5	6	6	6	6	6	6
1780	1.06	1.11	.95	1.08	.95	.82	1.04	.96	.95	.95	6	6	6	7	7	7	7	7	7	7
1790	1.11	1.43	.87	.69	.85	1.02	1.06	.88	1.02	1.03	7	7	7	7	7	7	7	7	7	7
1800	1.02	.96	.94	.86	.79	.87	1.00	1.05	.97	1.13	7	7	7	7	7	7	7	7	7	7
1810	1.00	1.06	1.04	1.02	.98	.92	1.11	1.06	1.03	.98	8	8	8	8	8	8	8	8	8	8
1820	.98	.97	.89	.94	1.12	.98	1.04	.92	1.10	.99	8	8	8	8	8	8	8	8	8	8
1830	.94	.99	1.10	.85	1.04	.97	.95	.89	.94	.92	8	8	8	8	8	8	8	8	8	8
1840	1.01	1.12	1.05	1.02	.96	1.09	1.10	.81	.94	.93	8	8	8	8	8	8	8	8	8	8
1850	1.03	.94	.97	1.07	1.07	.93	.96	.88	.96	1.07	8	8	8	8	8	8	8	8	8	8
1860	1.01	1.15	1.14	.96	.92	.66	1.09	1.03	1.13	.80	8	8	8	8	8	8	10	10	10	10
1870	1.07	1.08	1.07	1.03	.98	1.11	.61	.97	1.03	1.14	10	10	10	10	10	10	10	10	10	10
1880	.77	.77	1.15	1.36	.87	.93	.92	.99	1.01	1.01	10	10	10	10	10	10	10	10	10	10
1890	.97	1.14	.95	1.14	.98	.91	.98	1.01	.61	1.13	10	10	10	10	10	10	10	10	10	10
1900	1.14	1.07	.98	1.06	.87	1.04	.91	.91	1.09	.96	10	10	10	10	10	10	10	10	10	10
1910	1.07	1.04	.99	1.08	1.09	.73	1.02	.96	.94	1.11	10	10	10	10	10	10	10	10	10	10
1920	.85	1.07	.99	1.13	.95	1.10	.91	1.06	.89	.93	10	10	10	10	10	10	10	10	10	10
1930	1.03	.87	1.01	.99	1.02	1.27	.81	1.11	1.22	.48	10	10	10	10	10	10	10	10	10	10
1940	.96	1.19	.93	.95	1.00	1.05	.99	.92	1.18	.91	10	10	10	10	10	10	10	10	10	10
1950	1.11	.98	.93	1.02	.94	1.22	.97	.86	.96	1.08	10	10	10	10	10	10	10	10	10	10
1960	1.13	.91	.81	1.07	1.06	1.03	1.21	.71	.96	.90	10	10	10	10	10	10	10	10	10	10
1970	1.16	1.01	1.08	.91	.97	.98	.84	1.09	.95	1.12	10	10	10	10	10	10	10	10	10	8

PRELUDE LAKE SELECT RING WIDTH "B&C" CHRONOLOGY
YEARS: 1700 1979

	TREE RING INDICES										NUMBER OF RADII									
DATE	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
1700	.80	.92	1.56	1.74	1.14	.89	.80	.98	.59	.98	1	1	1	1	1	1	1	1	1	1
1710	.74	.63	.73	.70	.81	.82	.83	1.24	1.35	1.11	1	1	1	1	1	1	1	1	1	1
1720	1.26	.91	.65	.65	.78	.53	.57	.51	.86	.62	1	1	1	1	1	1	1	1	1	1
1730	.55	.66	1.03	.77	.78	1.07	1.04	1.28	1.44	1.44	3	3	3	3	3	3	3	3	3	3
1740	1.03	1.13	1.27	1.40	1.29	.88	.77	.61	.78	.88	3	3	3	4	4	4	4	5	5	5
1750	.86	.93	.75	.90	1.33	1.25	1.06	1.15	1.09	1.07	5	5	5	5	5	5	5	5	5	5
1760	1.22	1.06	.92	.77	.68	.57	.81	.90	1.20	.85	5	5	5	5	5	5	5	5	5	5
1770	1.05	.98	1.06	1.00	1.01	.76	1.06	1.24	.91	1.06	5	5	5	5	6	6	6	6	6	6
1780	1.17	1.24	1.03	1.23	1.01	.87	1.08	1.01	1.03	1.09	6	6	6	7	7	7	7	7	7	7
1790	1.32	1.61	.87	.59	.64	.73	.72	.57	.66	.64	7	7	7	7	7	7	7	7	7	7
1800	.62	.56	.54	.51	.54	.70	.95	1.18	1.24	1.59	7	7	7	7	7	7	7	7	7	7
1810	1.40	1.53	1.48	1.41	1.31	1.19	1.37	1.23	1.10	.87	8	8	8	8	8	8	8	8	8	8
1820	.78	.79	.71	.76	.91	.80	.92	.87	1.05	.96	8	8	8	8	8	8	8	8	8	8
1830	.85	.88	.95	.75	.87	.78	.76	.72	.79	.84	8	8	8	8	8	8	8	8	8	8
1840	1.02	1.24	1.18	1.15	1.06	1.17	1.11	.79	.88	.85	8	8	8	8	8	8	8	8	8	8
1850	.93	.88	.92	1.06	1.08	.94	.97	.93	1.10	1.34	8	8	8	8	8	8	8	8	8	8
1860	1.31	1.52	1.42	1.10	.97	.65	1.10	1.06	1.18	.84	8	8	8	8	8	8	10	10	10	10
1870	1.13	1.14	1.10	.99	.87	.89	.46	.71	.78	.90	10	10	10	10	10	10	10	10	10	10
1880	.66	.73	1.17	1.46	.93	1.08	1.08	1.09	1.15	1.18	10	10	10	10	10	10	10	10	10	10
1890	1.16	1.39	1.14	1.32	1.06	.90	.89	.91	.57	1.09	10	10	10	10	10	10	10	10	10	10
1900	1.16	1.11	1.00	1.03	.82	.97	.86	.86	1.09	1.00	10	10	10	10	10	10	10	10	10	10
1910	1.16	1.14	1.04	1.09	1.01	.64	.87	.88	.88	.99	10	10	10	10	10	10	10	10	10	10
1920	.79	1.03	1.08	1.15	.97	1.08	.86	.97	.78	.81	10	10	10	10	10	10	10	10	10	10
1930	.91	.81	1.08	1.04	1.13	1.43	.88	1.12	1.12	.41	10	10	10	10	10	10	10	10	10	10
1940	.80	1.01	.82	.87	.95	1.04	1.02	.98	1.27	.98	10	10	10	10	10	10	10	10	10	10
1950	1.18	.94	.96	1.07	.99	1.29	1.02	.88	.99	1.10	10	10	10	10	10	10	10	10	10	10
1960	1.15	.92	.79	1.07	1.09	1.05	1.20	.67	.89	.85	10	10	10	10	10	10	10	10	10	10
1970	1.14	1.00	1.06	.88	.92	.94	.84	1.16	1.10	1.37	10	10	10	10	10	10	10	10	10	8

PRELUDE LAKE SELECT MAXIMUM DENSITY "B" CHRONOLOGY
YEARS: 1700 1979

	TREE RING INDICES										NUMBER OF RADII									
DATE	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
1700	1.06	1.06	1.07	1.06	1.05	1.03	1.01	1.00	.98	.96	1	1	1	1	1	1	1	1	1	1
1710	.94	.92	.91	.91	.93	.94	.96	.98	1.00	1.01	1	1	1	1	1	1	1	1	1	1
1720	1.00	.98	.94	.91	.90	.91	.94	.97	.99	.97	1	1	1	1	1	1	1	1	1	1
1730	.92	.94	.97	.99	1.01	1.03	1.04	1.06	1.06	1.06	3	3	3	3	3	3	3	3	3	3
1740	1.05	1.05	1.05	1.03	1.01	.98	.94	.93	.93	.94	3	3	3	4	4	4	4	5	5	5
1750	.95	.96	.97	.98	1.00	1.02	1.03	1.04	1.05	1.06	5	5	5	5	5	5	5	5	5	5
1760	1.06	1.05	1.03	1.00	.98	.97	.96	.96	.96	.96	5	5	5	5	5	5	5	5	5	5
1770	.97	.99	1.00	1.01	1.01	1.00	1.00	1.01	1.03	1.04	5	5	5	5	6	6	6	6	6	6
1780	1.05	1.05	1.05	1.05	1.04	1.02	1.02	1.01	1.01	1.01	6	6	6	7	7	7	7	7	7	7
1790	1.01	1.00	.98	.96	.95	.95	.96	.96	.97	.97	7	7	7	7	7	7	7	7	7	7
1800	.97	.96	.95	.95	.95	.97	1.00	1.02	1.04	1.05	7	7	7	7	7	7	7	7	7	7
1810	1.03	1.02	1.02	1.02	1.03	1.03	1.03	1.03	1.02	1.02	8	8	8	8	8	8	8	8	8	8
1820	1.00	1.00	.99	.99	.98	.98	.98	.99	.99	.99	8	8	8	8	8	8	8	8	8	8
1830	.98	.97	.95	.94	.94	.94	.95	.96	.98	1.00	8	8	8	8	8	8	8	8	8	8
1840	1.01	1.02	1.03	1.03	1.04	1.05	1.04	1.02	1.00	.98	8	8	8	8	8	8	8	8	8	8
1850	.98	.99	1.00	1.01	1.02	1.01	1.01	1.00	1.01	1.02	8	8	8	8	8	8	8	8	8	8
1860	1.03	1.04	1.03	1.02	1.01	1.00	1.01	1.02	1.02	1.02	8	8	8	8	8	8	10	10	10	10
1870	1.01	1.00	.99	.98	.98	.98	.99	1.00	1.00	.99	10	10	10	10	10	10	10	10	10	10
1880	.99	.98	.99	.99	.99	.98	.98	.98	.99	1.00	10	10	10	10	10	10	10	10	10	10
1890	1.00	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.00	1.01	10	10	10	10	10	10	10	10	10	10
1900	1.03	1.04	1.03	1.03	1.03	1.02	1.02	1.02	1.02	1.01	10	10	10	10	10	10	10	10	10	10
1910	1.02	1.01	1.01	1.00	.98	.97	.96	.96	.97	.98	10	10	10	10	10	10	10	10	10	10
1920	.99	.99	.99	.99	.99	.99	.98	.97	.97	.97	10	10	10	10	10	10	10	10	10	10
1930	.99	1.00	1.01	1.02	1.03	1.03	1.02	1.00	.98	.96	10	10	10	10	10	10	10	10	10	10
1940	.95	.96	.97	.99	1.01	1.03	1.03	1.04	1.04	1.04	10	10	10	10	10	10	10	10	10	10
1950	1.05	1.05	1.04	1.04	1.03	1.03	1.02	1.01	1.00	.99	10	10	10	10	10	10	10	10	10	10
1960	.97	.96	.96	.97	.98	.98	.98	.98	.99	1.00	10	10	10	10	10	10	10	10	10	10
1970	1.01	1.01	1.01	1.01	1.01	1.01	1.02	1.03	1.05	1.04	10	10	10	10	10	10	10	10	10	8

PRELUDE LAKE SELECT MAXIMUM DENSITY "C" CHRONOLOGY
YEARS: 1700 1979

	TREE RING INDICES										NUMBER OF RADII									
DATE	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
1700	1.00	.97	1.01	1.07	.95	1.03	.98	1.06	.86	1.13	1	1	1	1	1	1	1	1	1	1
1710	1.00	.96	.95	.94	1.00	1.01	.88	1.00	1.01	.99	1	1	1	1	1	1	1	1	1	1
1720	1.11	1.04	.94	.90	1.00	.95	.84	1.00	1.37	.91	1	1	1	1	1	1	1	1	1	1
1730	.87	1.02	1.07	.99	1.00	.96	.99	1.04	1.04	1.00	3	3	3	3	3	3	3	3	3	3
1740	.96	.97	1.02	1.00	1.02	.90	1.07	.91	1.00	1.00	3	3	3	4	4	4	4	5	5	5
1750	1.04	1.02	.93	.97	1.06	1.00	1.00	.97	.99	1.04	5	5	5	5	5	5	5	5	5	5
1760	1.01	1.02	1.03	.98	.96	.97	1.01	1.02	.99	.99	5	5	5	5	5	5	5	5	5	5
1770	.95	1.01	1.02	1.03	1.01	.99	.97	1.00	.98	1.02	5	5	5	5	6	6	6	6	6	6
1780	1.03	.98	1.02	1.00	1.00	.96	1.01	1.02	.98	.96	6	6	6	7	7	7	7	7	7	7
1790	1.03	1.07	1.03	.00	1.01	1.02	.98	.99	1.01	1.02	7	7	7	7	7	7	7	7	7	7
1800	1.00	.99	1.04	.95	.97	.98	1.00	1.01	1.05	1.02	7	7	7	7	7	7	7	7	7	7
1810	1.01	.97	1.02	.96	1.01	1.04	.99	.99	1.04	.97	8	8	8	8	8	8	8	8	8	8
1820	1.00	1.01	1.01	.95	1.04	.98	1.02	.95	1.04	1.00	8	8	8	8	8	8	8	8	8	8
1830	1.02	1.00	.99	.96	1.02	1.06	.00	1.01	1.04	1.00	8	8	8	8	8	8	8	8	8	8
1840	1.03	.97	1.03	.98	.99	1.02	1.06	1.04	.95	.93	8	8	8	8	8	8	8	8	8	8
1850	1.02	.97	1.01	1.03	1.03	.98	1.02	.98	.97	1.00	8	8	8	8	8	8	8	8	8	8
1860	1.00	1.04	1.02	1.00	1.00	.92	1.01	1.00	1.04	1.01	8	8	8	8	8	8	10	10	10	10
1870	.98	1.00	.98	1.05	.94	1.03	.92	1.06	1.05	1.04	10	10	10	10	10	10	10	10	10	10
1880	.90	.97	1.04	1.06	.93	.99	1.04	1.00	.93	1.02	10	10	10	10	10	10	10	10	10	10
1890	1.06	.98	1.00	.98	.99	1.04	1.01	.99	.96	.95	10	10	10	10	10	10	10	10	10	10
1900	1.05	1.05	.98	1.00	.98	1.00	1.05	.94	1.02	.99	10	10	10	10	10	10	10	10	10	10
1910	1.00	1.04	.98	1.02	1.00	1.02	.96	.99	.95	1.06	10	10	10	10	10	10	10	10	10	10
1920	1.00	1.03	.96	.98	.99	1.09	1.00	.97	.91	1.04	10	10	10	10	10	10	10	10	10	10
1930	1.01	.99	1.00	1.01	1.00	1.06	.93	1.05	1.07	.85	10	10	10	10	10	10	10	10	10	10
1940	1.02	1.04	.93	1.01	1.00	1.04	1.04	.94	1.01	1.02	10	10	10	10	10	10	10	10	10	10
1950	1.01	.98	1.01	1.04	.91	1.07	.99	.97	1.04	.97	10	10	10	10	10	10	10	10	10	10
1960	1.00	.89	.97	1.04	1.00	1.01	1.03	.95	.97	1.05	10	10	10	10	10	10	10	10	10	10
1970	.98	1.04	1.01	.95	1.02	1.04	.91	1.02	1.00	1.04	10	10	10	10	10	10	10	10	10	8

PRELUDE LAKE SELECT MAXIMUM DENSITY "D&C" CHRONOLOGY
YEARS: 1700 1979

	TREE RING INDICES										NUMBER OF RADII									
DATE	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
1700	1.06	1.03	1.08	1.14	1.00	1.06	.99	1.06	.84	1.09	1	1	1	1	1	1	1	1	1	1
1710	.94	.89	.87	.86	1.00	.95	.85	1.06	1.01	1.00	1	1	1	1	1	1	1	1	1	1
1720	1.11	1.01	.88	.82	.97	.86	.79	.97	1.35	.89	1	1	1	1	1	1	1	1	1	1
1730	.88	.97	1.04	.99	1.01	.99	1.03	1.10	1.10	1.06	3	3	3	3	3	3	3	3	3	3
1740	1.02	1.02	1.07	1.12	1.03	.88	1.01	.85	.93	.94	3	3	3	4	4	4	4	5	5	5
1750	.99	.98	.98	.96	1.06	1.01	1.03	1.00	1.04	1.10	5	5	5	5	5	5	5	5	5	5
1760	1.07	1.07	1.07	.99	.95	.94	.96	.97	.95	.95	5	5	5	5	5	5	5	5	5	5
1770	.93	1.00	1.03	1.04	1.01	.99	.97	1.02	1.01	1.07	5	5	5	5	6	6	6	6	6	6
1780	1.09	1.04	1.07	1.05	1.04	.98	1.03	1.04	.99	.97	6	6	6	7	7	7	7	7	7	7
1790	1.03	1.07	1.01	.85	.96	.98	.94	.96	.97	.99	7	7	7	7	7	7	7	7	7	7
1800	.97	.94	.99	.98	.93	.95	.99	1.03	1.09	1.06	7	7	7	7	7	7	7	7	7	7
1810	1.04	.99	1.03	.97	1.03	1.08	1.02	1.02	1.06	.99	8	8	8	8	8	8	8	8	8	8
1820	1.00	1.00	1.00	.94	1.02	.97	1.01	.93	1.03	.99	8	8	8	8	8	8	8	8	8	8
1830	1.01	.97	.94	.98	.95	.99	.83	.97	1.02	1.00	8	8	8	8	8	8	8	8	8	8
1840	1.04	.99	1.06	1.01	1.03	1.07	1.10	1.06	.94	.91	8	8	8	8	8	8	8	8	8	8
1850	1.00	.95	1.01	1.04	1.04	.99	1.02	.98	.98	1.02	8	8	8	8	8	8	8	8	8	8
1860	1.03	1.08	1.05	1.02	1.00	.93	1.02	1.02	1.07	1.04	8	8	8	8	8	8	10	10	10	10
1870	.99	1.01	.97	1.03	.92	1.01	.91	1.06	1.05	1.03	10	10	10	10	10	10	10	10	10	10
1880	.89	.96	1.03	1.05	.92	.97	1.02	.99	.92	1.01	10	10	10	10	10	10	10	10	10	10
1890	1.06	.98	1.00	.99	1.01	1.05	1.03	1.00	.96	.96	10	10	10	10	10	10	10	10	10	10
1900	1.08	1.09	1.01	1.03	1.00	1.02	1.08	.96	1.03	1.00	10	10	10	10	10	10	10	10	10	10
1910	1.02	1.06	.98	1.02	.98	.99	.92	.95	.92	1.04	10	10	10	10	10	10	10	10	10	10
1920	.99	1.02	.95	.97	.98	1.08	.98	.94	.88	1.01	10	10	10	10	10	10	10	10	10	10
1930	1.00	.99	1.01	1.03	1.03	1.09	.94	1.05	1.05	.82	10	10	10	10	10	10	10	10	10	10
1940	.97	.99	.98	1.00	1.00	1.06	1.08	.97	1.05	1.07	10	10	10	10	10	10	10	10	10	10
1950	1.06	1.02	1.05	1.08	.94	1.11	1.01	.99	1.04	.96	10	10	10	10	10	10	10	10	10	10
1960	1.05	.86	.94	1.01	.97	.99	1.02	.93	.96	1.05	10	10	10	10	10	10	10	10	10	10
1970	.98	1.06	1.02	.96	1.02	1.05	.93	1.05	1.05	1.08	10	10	10	10	10	10	10	10	10	8

APPENDIX 2

Manitoba Transect chronologies from south to north.

Riding Mountain
Beautiful Lake[a]
Root Lake[b]
Suwannee River (white spruce)
Suwannee River (black spruce)
Churchill River[c]

[a] Beautiful Lake is the name used in this appendix for the Duck Mountain site referred to in the text.

[b] Root Lake is the name used in this appendix for The Pas site referred to in the text.

[c] Only the C chronologies are available for the Churchill River site.

Site: RIDING MOUNTAIN, MAN. Species: WHITE SPRUCE (PICEA GLAUCA)
Longitude: 99 deg. 60 min. W Latitude: 50 deg. 45 min. N
Date collected: SEPT. 19,1981 Collectors: L.A. JOZSA, W.B. SCHULTZ
Tree-ring parameter: RING WIDTH
Chronology type: "B"
YEARS: 1864 1981

TREE RING INDICES

DATE	0	1	2	3	4	5	6	7	8	9
1860					.76	.80	.86	.90	.94	.90
1870	.99	1.04	1.09	1.11	1.11	1.09	1.06	1.05	.98	1.01
1880	1.02	1.00	.96	.93	.92	.92	.92	.95	.97	1.00
1890	1.03	1.06	1.09	1.08	1.06	1.06	1.06	1.07	1.07	1.05
1900	1.01	1.00	1.01	1.03	1.04	1.03	1.01	.99	.97	.96
1910	.97	.98	.99	.97	.93	.90	.87	.85	.82	.79
1920	.77	.80	.88	.99	1.08	1.12	1.11	1.05	.99	.94
1930	.89	.86	.84	.83	.81	.79	.78	.78	.78	.80
1940	.83	.90	1.00	1.09	1.15	1.17	1.16	1.12	1.08	1.07
1950	1.09	1.12	1.15	1.16	1.16	1.15	1.13	1.09	1.03	.94
1960	.83	.76	.74	.80	.89	.97	1.01	1.04	1.07	1.11
1970	1.16	1.21	1.23	1.24	1.24	1.22	1.17	1.07	.93	.76
1980	.59	.44								

NUMBER OF RADII

0	1	2	3	4	5	6	7	8	9
				1	1	2	2	2	2
3	3	3	3	3	3	4	4	8	11
12	12	12	13	13	13	14	14	14	14
15	15	17	17	17	17	17	17	17	17
18	18	19	19	19	19	19	19	19	19
19	19	19	19	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20								

Site: RIDING MOUNTAIN, MAN. Species: WHITE SPRUCE (PICEA GLAUCA)
Longitude: 99 deg. 60 min. W Latitude: 50 deg. 45 min. N
Date collected: SEPT. 19,1981 Collectors: L.A. JOZSA, W.B. SCHULTZ
Tree-ring parameter: RING WIDTH
Chronology type: "C"
YEARS: 1864 1981

TREE RING INDICES

DATE	0	1	2	3	4	5	6	7	8	9
1860					1.11	.87	1.00	1.09	.99	.94
1870	.99	.98	.97	1.22	.95	.90	1.12	1.02	.85	.97
1880	1.00	1.13	.93	.92	.86	1.16	.94	.92	1.07	1.03
1890	.92	1.02	1.05	1.04	.96	.96	.93	1.05	1.07	1.06
1900	.92	.92	.94	1.05	1.09	1.01	1.01	.82	1.21	.91
1910	.87	.99	1.12	1.15	.89	.91	1.09	.91	1.00	1.13
1920	.73	.83	.92	.98	1.19	1.17	.91	1.02	.97	1.04
1930	.98	.75	1.20	1.02	.87	1.10	.88	.99	1.00	1.00
1940	.77	.83	1.19	1.02	.99	1.00	1.11	1.00	.81	1.00
1950	.84	1.04	1.09	1.01	.91	1.17	.83	1.09	1.10	1.12
1960	.92	.71	.76	.93	.95	1.31	1.02	.76	1.00	1.02
1970	.91	1.03	1.00	1.03	.92	.99	1.22	.93	1.24	.88
1980	.63	1.40								

NUMBER OF RADII

0	1	2	3	4	5	6	7	8	9
				1	1	2	2	2	2
3	3	3	3	3	3	4	4	8	11
12	12	12	13	13	13	14	14	14	14
15	15	17	17	17	17	17	17	17	17
18	18	19	19	19	19	19	19	19	19
19	19	19	19	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20								

Site: RIDING MOUNTAIN, MAN. Species: WHITE SPRUCE (PICEA GLAUCA)
Longitude: 99 deg. 60 min. W Latitude: 50 deg. 45 min. N
Date collected: SEPT. 19,1981 Collectors: L.A. JOZSA, W.B. SCHULTZ
Tree-ring parameter: RING WIDTH
Chronology type: "B&C"
YEARS: 1864 1981

TREE RING INDICES

DATE	0	1	2	3	4	5	6	7	8	9
1860					.84	.70	.86	.99	.93	.92
1870	.98	1.01	1.06	1.35	1.05	.98	1.18	1.06	.83	.97
1880	1.11	1.12	.98	.87	.79	1.06	.87	.87	1.04	1.03
1890	.96	1.08	1.15	1.13	1.03	1.01	.98	1.12	1.15	1.11
1900	.93	.93	.95	1.08	1.13	1.04	1.02	.81	1.18	.88
1910	.85	.97	1.11	1.12	.83	.83	.95	.77	.88	.89
1920	.58	.67	.82	.98	1.29	1.32	1.01	1.09	.97	.98
1930	.87	.65	1.01	.85	.70	.88	.69	.77	.85	.80
1940	.66	.75	1.20	1.10	1.13	1.27	1.28	1.13	.88	1.16
1950	.92	1.17	1.25	1.18	1.07	1.35	.94	1.20	1.14	1.05
1960	.78	.54	.58	.75	.85	1.27	1.03	.80	1.17	1.16
1970	1.06	1.25	1.35	1.29	1.14	1.21	1.43	1.00	1.16	.69
1980	.39	.56								

NUMBER OF RADII

0	1	2	3	4	5	6	7	8	9
				1	1	2	2	2	2
3	3	3	3	3	3	4	4	8	11
12	12	12	13	13	13	14	14	14	14
15	15	17	17	17	17	17	17	17	17
18	18	19	19	19	19	19	19	19	19
19	19	19	19	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20								

Site: RIDING MOUNTAIN, MAN. Species: WHITE SPRUCE (PICEA GLAUCA)
Longitude: 99 deg. 60 min. W Latitude: 50 deg. 45 min. N
Date collected: SEPT. 19,1981 Collectors: L.A. JOZSA, W.B. SCHULTZ
Tree-ring parameter: MAXIMUM RING DENSITY
Chronology type: "B"
YEARS: 1864 1981

TREE RING INDICES

DATE	0	1	2	3	4	5	6	7	8	9
1860					1.00	.99	1.00	1.00	1.02	1.02
1870	.99	.99	.98	.99	1.00	1.01	1.02	1.02	.98	.98
1880	.98	.99	1.00	1.00	1.00	1.00	1.00	1.00	.99	.99
1890	.99	1.00	1.01	1.02	1.02	1.01	1.00	1.00	1.00	1.00
1900	1.01	1.01	1.00	.99	.98	.98	.97	.97	.98	.99
1910	1.00	1.00	1.01	1.01	1.01	1.01	1.00	1.00	.99	.99
1920	1.00	1.00	1.00	1.01	1.00	1.00	.99	.99	.99	.99
1930	1.00	1.02	1.03	1.02	1.01	1.00	1.00	1.00	1.00	1.00
1940	1.00	1.00	1.00	1.01	1.02	1.02	1.02	1.02	1.01	1.00
1950	1.00	1.00	1.00	1.01	1.01	1.01	1.02	1.02	1.01	.99
1960	.98	.97	.97	.98	.99	1.00	1.00	1.00	1.01	1.03
1970	1.04	1.05	1.04	1.03	1.02	1.02	1.02	1.00	.98	.95
1980	.93	.92								

NUMBER OF RADII

0	1	2	3	4	5	6	7	8	9
				1	1	2	2	2	2
3	3	3	3	3	3	4	4	8	11
12	12	12	13	13	13	14	14	14	14
15	15	17	17	17	17	17	17	17	17
18	18	19	19	19	19	19	19	19	19
19	19	19	19	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20								

Site: RIDING MOUNTAIN, MAN. Species: WHITE SPRUCE (PICEA GLAUCA)
Longitude: 99 deg. 60 min. W Latitude: 50 deg. 45 min. N
Date collected: SEPT. 19,1981 Collectors: L.A. JOZSA, M.B. SCHULTZ
Tree-ring parameter: MAXIMUM RING DENSITY
Chronology type: "C"
YEARS: 1864 1981

TREE RING INDICES

DATE	0	1	2	3	4	5	6	7	8	9
1860					1.11	.97	.96	.96	1.01	1.07
1870	1.03	.97	1.00	.92	1.00	1.00	.95	1.04	1.02	1.03
1880	.92	1.05	1.00	.99	1.05	.94	1.02	1.02	.98	1.06
1890	.92	1.02	.99	1.03	1.03	1.01	.96	1.03	.98	.95
1900	1.03	1.07	.99	.95	1.00	1.04	1.05	.82	1.07	1.05
1910	.99	.99	.96	1.04	1.00	1.00	1.02	.98	.96	1.07
1920	.93	1.00	1.03	1.02	.96	1.02	1.03	.98	.97	.99
1930	.98	1.01	1.03	1.06	.96	.97	.99	1.00	1.01	1.02
1940	.96	.99	1.01	.97	1.05	.97	1.03	1.02	.99	1.00
1950	.96	1.00	1.04	.97	.97	1.04	.98	1.02	1.03	1.02
1960	.97	.95	.96	1.04	1.02	.99	1.03	.98	.94	1.02
1970	1.03	1.01	1.01	1.02	.94	.96	1.06	1.04	1.01	.94
1980	.97	1.05								

NUMBER OF RADII

0	1	2	3	4	5	6	7	8	9
				1	1	2	2	2	2
3	3	3	3	3	3	4	4	8	11
12	12	12	13	13	13	14	14	14	14
15	15	17	17	17	17	17	17	17	17
18	18	19	19	19	19	19	19	19	19
19	19	19	19	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20								

Site: RIDING MOUNTAIN, MAN. Species: WHITE SPRUCE (PICEA GLAUCA)
Longitude: 99 deg. 60 min. W Latitude: 50 deg. 45 min. N
Date collected: SEPT. 19,1981 Collectors: L.A. JOZSA, M.B. SCHULTZ
Tree-ring parameter: MAXIMUM RING DENSITY
Chronology type: "B&C"
YEARS: 1864 1981

TREE RING INDICES

DATE	0	1	2	3	4	5	6	7	8	9
1860					1.11	.96	.95	.96	1.02	1.08
1870	1.02	.96	.98	.91	1.00	1.01	.97	1.06	1.00	1.00
1880	.98	1.04	1.00	.99	1.05	.94	1.02	1.01	.97	1.05
1890	.91	1.01	1.00	1.05	1.05	1.02	.96	1.03	.98	.96
1900	1.04	1.09	.99	.94	.98	1.01	1.02	.80	1.05	1.03
1910	.98	1.00	.97	1.06	1.01	1.01	1.03	.98	.95	1.07
1920	.93	1.00	1.03	1.02	.97	1.02	1.03	.97	.96	.98
1930	.98	1.02	1.05	1.09	.97	.97	.99	1.00	1.01	1.02
1940	.96	.99	1.01	.98	1.06	.99	1.05	1.03	1.00	1.00
1950	.97	1.00	1.04	.98	.98	1.06	1.00	1.04	1.03	1.01
1960	.95	.92	.93	1.02	1.02	.99	1.03	.99	.95	1.05
1970	1.07	1.06	1.06	1.06	.96	.98	1.00	1.04	.99	.98
1980	.91	.97								

NUMBER OF RADII

0	1	2	3	4	5	6	7	8	9
				1	1	2	2	2	2
3	3	3	3	3	3	4	4	8	11
12	12	12	13	13	13	14	14	14	14
15	15	17	17	17	17	17	17	17	17
18	18	19	19	19	19	19	19	19	19
19	19	19	19	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20								

Site: BEAUTIFUL LAKE, MAN. Species: WHITE SPRUCE (PICEA GLAUCA)
Longitude: 101 deg. 04 min. W Latitude: 51 deg. 35 min. N
Date collected: SEPT. 20,1981 Collectors: L.A. JOZSA, N.B. SCHULTZ
Tree-ring parameter: RING WIDTH
Chronology type: "B"
YEARS: 1793 1981

TREE RING INDICES

DATE	0	1	2	3	4	5	6	7	8	9
1790				1.01	1.08	1.15	1.17	1.14	1.08	1.00
1800	.97	.95	.93	.91	.91	.97	1.11	1.25	1.09	1.07
1810	1.01	.95	.90	.88	.87	.84	.86	.88	.91	.94
1820	.97	.99	1.02	1.03	1.04	1.06	1.09	1.13	1.16	1.15
1830	1.12	1.08	1.04	.99	.93	.86	.77	.77	.80	.84
1840	.84	.89	.94	1.01	1.10	1.11	1.15	1.15	1.14	1.13
1850	1.15	1.16	1.15	1.11	1.04	.95	.87	.81	.79	.79
1860	.83	.87	.91	.98	.88	.87	.87	.88	.89	.92
1870	.97	1.01	1.04	1.05	1.03	1.02	1.03	1.06	1.14	1.17
1880	1.17	1.14	1.08	1.01	.94	.86	.78	.74	.70	.69
1890	.70	.74	.81	.91	1.00	1.10	1.17	1.22	1.26	1.29
1900	1.28	1.28	1.27	1.26	1.23	1.18	1.12	1.07	1.03	1.00
1910	.98	.96	.94	.91	.87	.83	.81	.81	.82	.84
1920	.88	.93	1.01	1.08	1.13	1.15	1.13	1.08	1.00	.90
1930	.78	.68	.64	.65	.69	.71	.71	.70	.69	.72
1940	.78	.89	1.01	1.12	1.21	1.25	1.25	1.21	1.16	1.12
1950	1.12	1.13	1.13	1.11	1.08	1.04	1.02	1.01	.98	.92
1960	.83	.75	.73	.77	.85	.93	.99	1.04	1.10	1.16
1970	1.22	1.25	1.24	1.19	1.14	1.09	1.04	.97	.90	.83
1980	.75	.68								

NUMBER OF RADII

0	1	2	3	4	5	6	7	8	9
			1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	4	4
4	4	4	4	4	5	6	6	6	6
6	6	6	6	6	6	6	6	6	6
6	6	6	6	6	6	7	7	7	7
8	8	8	8	8	9	11	11	11	12
12	12	12	12	14	14	14	14	14	15
15	15	17	17	17	17	17	17	17	17
18	18	18	18	18	18	18	18	19	19
20	20	20	20	20	20	21	21	21	21
21	21	21	21	21	21	21	21	21	21
24	24	24	24	24	24	24	24	24	24

Site: BEAUTIFUL LAKE, MAN. Species: WHITE SPRUCE (PICEA GLAUCA)
Longitude: 101 deg. 04 min. W Latitude: 51 deg. 35 min. N
Date collected: SEPT. 20,1981 Collectors: L.A. JOZSA, N.B. SCHULTZ
Tree-ring parameter: RING WIDTH
Chronology type: "B&C"
YEARS: 1793 1981

TREE RING INDICES

DATE	0	1	2	3	4	5	6	7	8	9
1790				.75	1.07	1.38	1.24	1.31	.83	1.24
1800	.70	.97	1.09	.88	.92	.63	.64	1.78	1.43	.94
1810	.98	.91	.85	.91	.81	.78	1.00	.76	.93	.96
1820	.93	.98	1.15	.90	1.11	1.12	.85	1.23	1.29	1.24
1830	1.07	.98	1.15	1.04	.99	.74	.82	.56	.85	.87
1840	.84	.99	.81	.85	1.23	1.20	1.27	1.17	1.08	1.03
1850	1.14	1.30	1.19	1.13	1.09	.96	.87	.64	.82	.71
1860	.73	1.04	.92	.95	.88	.67	1.07	.85	.79	.91
1870	1.00	.94	1.16	1.18	.93	.99	.99	1.01	1.14	1.23
1880	1.30	1.14	1.12	.98	.88	.96	.74	.61	.77	.68
1890	.52	.82	.71	.88	1.07	1.13	1.20	1.23	1.27	1.35
1900	1.28	1.31	1.21	1.27	1.38	1.18	1.11	.90	1.19	.95
1910	.90	1.00	.93	.98	.99	.55	.91	.74	.85	.86
1920	.79	.83	1.10	1.10	1.12	1.38	.98	1.20	1.06	1.00
1930	.75	.48	.50	.68	.68	.83	.75	.63	.71	.63
1940	.61	.82	1.15	1.24	1.04	1.46	1.40	1.26	.95	1.22
1950	.95	1.16	1.26	1.21	.92	1.18	.76	1.08	1.14	.99
1960	1.01	.32	.61	.84	.69	1.19	1.03	.91	1.05	1.26
1970	1.15	1.44	1.34	1.13	1.04	1.18	1.15	.79	1.04	.86
1980	.60	.78								

NUMBER OF RADII

0	1	2	3	4	5	6	7	8	9
			1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	4	4
4	4	4	4	4	5	6	6	6	6
6	6	6	6	6	6	6	6	6	6
6	6	6	6	6	6	7	7	7	7
8	8	8	8	8	9	11	11	11	12
12	12	12	12	14	14	14	14	14	15
15	15	17	17	17	17	17	17	17	17
18	18	18	18	18	18	18	18	19	19
20	20	20	20	20	20	21	21	21	21
21	21	21	21	21	21	21	21	21	21
24	24	24	24	24	24	24	24	24	24
24	24	24	24	24	24	24	24	24	24
24	24	24	24	24	24	24	24	24	24
24	24	24	24	24	24	24	24	24	24
24	24	24	24	24	24	24	24	24	24
24	24	24	24	24	24	24	24	24	24
24	24	24	24	24	24	24	24	24	24
24	24								

Site: BEAUTIFUL LAKE, MAN. Species: WHITE SPRUCE (PICEA GLAUCA)
Longitude: 101 deg. 04 min. W Latitude: 51 deg. 35 min. N
Date collected: SEPT. 20,1981 Collectors: L.A. JOZSA, N.B. SCHULTZ
Tree-ring parameter: MAXIMUM RING DENSITY
Chronology type: "B"
YEARS: 1793 1981

TREE RING INDICES

DATE	0	1	2	3	4	5	6	7	8	9
1790				1.01	1.02	1.02	1.01	1.00	.99	.99
1800	.97	.97	.98	1.00	1.01	1.03	1.04	1.04	1.02	1.01
1810	1.00	1.00	.99	.99	.98	.98	.96	.97	.98	1.00
1820	1.00	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.01
1830	1.00	.98	.98	.98	.97	.96	.93	.94	.97	1.00
1840	1.00	1.01	1.01	1.01	1.01	1.02	1.03	1.03	1.02	1.01
1850	1.01	1.01	1.01	1.01	1.00	1.00	.99	.99	.99	.99
1860	.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1870	1.00	1.00	1.00	1.00	1.00	1.01	1.01	1.01	1.01	1.01
1880	1.01	1.01	1.01	1.01	1.01	1.00	1.00	.99	.99	.99
1890	.98	.99	1.00	1.01	1.02	1.02	1.02	1.01	1.01	1.01
1900	1.02	1.02	1.01	1.00	1.00	.99	.99	.98	.98	.99
1910	1.00	1.00	1.01	1.01	1.01	1.00	.99	.99	.99	1.00
1920	1.01	1.02	1.02	1.02	1.02	1.01	1.01	1.00	.99	.98
1930	.97	.97	.98	.98	.98	.98	.98	.97	.97	.97
1940	.98	.99	1.00	1.00	1.00	1.01	1.01	1.02	1.02	1.02
1950	1.02	1.02	1.01	1.01	1.01	1.01	1.02	1.02	1.02	1.01
1960	1.00	.98	.98	.98	.99	.99	1.00	1.00	1.01	1.02
1970	1.02	1.03	1.02	1.00	.99	.99	.99	1.00	1.00	1.00
1980	1.00	1.00								

NUMBER OF RADII

0	1	2	3	4	5	6	7	8	9
			1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	4	4
4	4	4	4	4	5	6	6	6	6
6	6	6	6	6	6	6	6	6	6
6	6	6	6	6	6	7	7	7	7
8	8	8	8	8	9	11	11	11	12
12	12	12	12	14	14	14	14	14	15
15	15	17	17	17	17	17	17	17	17
18	18	18	18	18	18	18	18	19	19
20	20	20	20	20	20	21	21	21	21
21	21	21	21	21	21	21	21	21	21
24	24	24	24	24	24	24	24	24	24
24	24	24	24	24	24	24	24	24	24
24	24	24	24	24	24	24	24	24	24
24	24	24	24	24	24	24	24	24	24
24	24	24	24	24	24	24	24	24	24
24	24	24	24	24	24	24	24	24	24
24	24	24	24	24	24	24	24	24	24
24	24								

Site: BEAUTIFUL LAKE, MAN. Species: WHITE SPRUCE (PICEA GLAUCA)
Longitude: 101 deg. 04 min. W Latitude: 51 deg. 35 min. N
Date collected: SEPT. 20,1981 Collectors: L.A. JOZSA, N.B. SCHULTZ
Tree-ring parameter: MAXIMUM RING DENSITY
Chronology type: "C"
YEARS: 1793 1981

TREE RING INDICES

DATE	0	1	2	3	4	5	6	7	8	9
1790				.93	1.07	1.00	1.02	.95	1.03	.99
1800	1.05	.94	1.00	.98	1.03	1.03	.98	1.06	1.01	1.01
1810	.99	.98	1.03	.99	1.00	1.00	1.03	.93	1.04	.98
1820	1.03	1.00	1.02	.99	.97	1.03	1.01	.99	.99	1.05
1830	.96	1.01	.98	.99	1.06	1.02	.96	.91	1.01	1.07
1840	.98	1.01	1.07	.94	1.00	.99	1.03	1.00	1.00	.99
1850	1.03	.95	1.02	1.03	1.00	.99	1.00	1.00	1.00	.98
1860	.99	1.02	1.01	1.01	.97	1.01	1.00	.99	1.00	1.02
1870	1.00	.99	.98	1.01	1.02	.99	.99	1.00	1.01	1.02
1880	.96	1.02	.98	1.02	1.04	.97	.96	1.03	1.01	1.02
1890	.93	1.03	.97	1.02	1.02	1.01	.99	1.02	.99	.95
1900	1.04	1.02	.97	.98	1.01	1.01	1.06	.86	1.07	1.00
1910	.99	1.00	.99	1.02	1.03	1.00	1.01	.95	.97	1.05
1920	.98	.99	1.04	1.03	.93	1.01	1.04	1.01	.98	1.03
1930	.94	.99	1.00	1.08	.97	.97	1.02	1.00	.99	1.00
1940	.96	1.02	1.02	.99	1.03	.93	1.03	1.01	1.01	1.00
1950	.98	.99	1.05	.99	.95	1.05	.96	1.01	1.01	1.03
1960	1.08	.83	1.01	1.06	.99	.95	1.05	1.00	.96	1.02
1970	1.01	1.02	1.01	1.03	.91	1.00	1.03	.99	1.03	.95
1980	1.02	1.01								

NUMBER OF RADII

0	1	2	3	4	5	6	7	8	9
			1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	4	4
4	4	4	4	4	5	6	6	6	6
6	6	6	6	6	6	6	6	6	6
6	6	6	6	6	6	7	7	7	7
8	8	8	8	8	9	11	11	11	12
12	12	12	12	14	14	14	14	14	15
15	15	17	17	17	17	17	17	17	17
18	18	18	18	18	18	18	18	19	19
20	20	20	20	20	20	21	21	21	21
21	21	21	21	21	21	21	21	21	21
24	24	24	24	24	24	24	24	24	24

Site: ROOT LAKE, MAN. Species: WHITE SPRUCE (PICEA GLAUCA)
Longitude: 101 deg. 22 min. W Latitude: 54 deg. 06 min. N
Date collected: SEPT.16&21,1981 Collectors: L.A. JOZSA, J.M. POWELL, N.B. SCHULTZ
Tree-ring parameter: RING WIDTH
Chronology type: "B"
YEARS: 1829 1981

TREE RING INDICES

DATE	0	1	2	3	4	5	6	7	8	9
1820										.71
1830	.78	.87	.94	.99	1.00	.98	.93	.83	.85	.91
1840	.98	1.06	1.14	1.20	1.20	1.17	1.11	1.02	.94	.90
1850	.91	.95	.99	1.02	1.06	1.11	1.15	1.17	1.13	1.10
1860	1.06	1.02	1.00	.98	.98	.98	.98	.93	.95	.99
1870	1.03	1.09	1.13	1.15	1.15	1.10	1.08	1.06	1.03	1.01
1880	.99	.95	.90	.84	.80	.79	.80	.84	.90	.96
1890	.97	.98	.97	.96	.96	.97	1.01	1.07	1.14	1.20
1900	1.25	1.27	1.26	1.22	1.16	1.08	1.03	.99	1.00	1.02
1910	1.02	1.01	.98	.95	.92	.90	.90	.89	.89	.89
1920	.90	.91	.91	.90	.89	.90	.92	.95	.95	.93
1930	.91	.89	.90	.93	.95	.95	.93	.90	.87	.86
1940	.85	.86	.89	.93	1.00	1.08	1.14	1.19	1.24	1.31
1950	1.39	1.46	1.46	1.40	1.29	1.15	1.03	.93	.87	.83
1960	.78	.75	.74	.77	.84	.91	.96	.95	.92	.89
1970	.92	1.00	1.09	1.18	1.24	1.27	1.28	1.25	1.20	1.13
1980	1.07	1.02								

NUMBER OF RADII

0	1	2	3	4	5	6	7	8	9
									2
2	2	2	2	2	2	2	3	3	3
3	3	3	4	5	5	5	5	5	5
5	5	5	5	5	5	5	5	6	6
6	6	6	6	6	6	6	7	7	7
8	8	8	8	8	9	9	9	9	9
9	10	10	13	13	13	13	14	14	14
16	16	16	16	16	16	16	16	16	16
16	16	16	17	17	17	18	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20								

Site: ROOT LAKE, MAN. Species: WHITE SPRUCE (PICEA GLAUCA)
Longitude: 101 deg. 22 min. W Latitude: 54 deg. 06 min. N
Date collected: SEPT.16&21,1981 Collectors: L.A. JOZSA, J.M. POWELL, N.B. SCHULTZ
Tree-ring parameter: RING WIDTH
Chronology type: "C"
YEARS: 1829 1981

TREE RING INDICES

DATE	0	1	2	3	4	5	6	7	8	9
1820										1.17
1830	.82	1.04	1.06	1.00	1.21	1.11	.72	1.08	.89	.87
1840	1.11	1.06	.82	.99	1.18	.92	1.19	.87	1.01	.80
1850	.83	1.10	1.18	.94	.82	1.02	1.20	.95	1.05	1.00
1860	1.01	.93	.97	1.06	.98	.87	1.12	1.03	.96	.96
1870	.88	1.08	1.04	1.10	.93	.99	1.02	1.17	.76	1.02
1880	1.11	.99	1.08	1.02	.77	1.13	.85	.92	.97	1.13
1890	1.03	1.04	.97	.98	.98	1.04	.80	.99	1.12	.96
1900	1.05	1.00	1.05	1.08	1.02	.99	.94	.75	1.13	1.06
1910	.97	1.09	.95	1.02	.95	1.04	.93	1.04	1.03	.96
1920	.98	1.09	1.04	1.07	.86	.97	.94	1.08	1.15	.93
1930	1.03	.76	1.17	.84	1.13	1.10	.95	.99	.99	.92
1940	.97	1.04	.89	.97	.98	1.03	1.14	.96	.87	.94
1950	1.01	1.06	1.18	1.07	.83	1.24	.79	.87	.96	1.14
1960	1.04	.75	1.06	.89	.74	1.23	1.17	.99	1.15	.71
1970	.77	1.03	1.11	1.01	1.01	.91	1.32	.78	1.07	1.16
1980	.69	1.17								

NUMBER OF RADII

0	1	2	3	4	5	6	7	8	9
									2
2	2	2	2	2	2	2	3	3	3
3	3	3	4	5	5	5	5	5	5
5	5	5	5	5	5	5	5	6	6
6	6	6	6	6	6	6	7	7	7
8	8	8	8	8	9	9	9	9	9
9	10	10	13	13	13	13	14	14	14
16	16	16	16	16	16	16	16	16	16
16	16	16	17	17	17	18	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20								

Site: ROOT LAKE, MAN. Species: WHITE SPRUCE (PICEA GLAUCA)
Longitude: 101 deg. 22 min. W Latitude: 54 deg. 06 min. N
Date collected: SEPT.16&21,1981 Collectors: L.A. JOZSA, J.M. POWELL, N.B. SCHULTZ
Tree-ring parameter: RING WIDTH
Chronology type: "B&C"
YEARS: 1829 1981

TREE RING INDICES

DATE	0	1	2	3	4	5	6	7	8	9
1820										.83
1830	.64	.90	.99	.99	1.21	1.07	.67	.89	.76	.78
1840	1.10	1.13	.93	1.18	1.42	1.10	1.31	.90	.95	.71
1850	.75	1.04	1.16	.96	.87	1.13	1.38	1.10	1.18	1.09
1860	1.07	.96	.98	1.05	.96	.85	1.09	.95	.91	.95
1870	.91	1.18	1.18	1.27	1.07	1.09	1.11	1.24	.78	1.03
1880	1.10	.96	.97	.86	.62	.89	.68	.78	.88	1.10
1890	1.00	1.02	.94	.94	.95	1.01	.81	1.06	1.28	1.15
1900	1.31	1.28	1.33	1.31	1.17	1.08	.98	.75	1.14	1.08
1910	.99	1.09	.92	.96	.87	.94	.83	.92	.91	.85
1920	.81	.99	.96	.96	.77	.87	.87	1.03	1.10	.87
1930	.94	.68	1.06	.78	1.07	1.05	.89	.89	.86	.81
1940	.84	.98	.88	.98	.91	1.13	1.33	1.16	1.09	1.25
1950	1.43	1.54	1.72	1.51	1.07	1.43	.81	.81	.84	.94
1960	.82	.56	.78	.69	.63	1.11	1.12	.95	1.06	.64
1970	.71	1.03	1.22	1.20	1.26	1.17	1.69	.97	1.29	1.33
1980	.74	1.17								

NUMBER OF RADII

0	1	2	3	4	5	6	7	8	9
									2
2	2	2	2	2	2	2	3	3	3
3	3	3	4	5	5	5	5	5	5
5	5	5	5	5	5	5	5	6	6
6	6	6	6	6	6	6	7	7	7
8	8	8	8	8	9	9	9	9	9
9	10	10	13	13	13	13	14	14	14
16	16	16	16	16	16	16	16	16	16
16	16	16	17	17	17	18	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20								

Site: ROOT LAKE, MAN. Species: WHITE SPRUCE (PICEA GLAUCA)
Longitude: 101 deg. 22 min. W Latitude: 54 deg. 06 min. N
Date collected: SEPT.16&21,1981 Collectors: L.A. JOZSA, J.M. POWELL, N.B. SCHULTZ
Tree-ring parameter: MAXIMUM RING DENSITY
Chronology type: "B"
YEARS: 1829 1981

TREE RING INDICES

DATE	0	1	2	3	4	5	6	7	8	9
1820										.98
1830	.99	.99	.99	1.00	1.00	1.00	1.00	.98	.98	.99
1840	1.00	1.01	1.02	1.03	1.04	1.02	1.00	.99	.98	.99
1850	1.01	1.02	1.02	1.02	1.02	1.02	1.01	1.01	1.02	1.02
1860	1.02	1.02	1.01	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1870	1.01	1.02	1.02	1.03	1.02	1.01	.99	.98	.97	.97
1880	.98	.99	1.01	1.01	1.01	1.00	.99	1.00	1.00	1.00
1890	.99	.99	.99	.99	1.00	1.00	1.00	1.00	1.01	1.01
1900	1.02	1.02	1.02	1.03	1.02	1.01	1.01	1.01	1.01	1.01
1910	1.01	1.01	1.01	1.01	1.00	.99	.99	.98	.98	.99
1920	.99	1.00	1.01	1.00	1.00	1.00	1.00	.99	.99	.99
1930	.99	.99	1.00	1.00	1.00	1.00	.99	.99	.99	.98
1940	.98	.98	.98	.99	1.00	1.01	1.02	1.03	1.03	1.03
1950	1.03	1.04	1.04	1.03	1.03	1.02	1.02	1.01	1.01	1.00
1960	.99	.98	.98	.99	1.00	1.01	1.01	1.01	1.00	1.00
1970	1.00	1.01	1.02	1.02	1.02	1.02	1.01	1.01	1.00	.99
1980	.97	.97								

NUMBER OF RADII

0	1	2	3	4	5	6	7	8	9
									2
2	2	2	2	2	2	2	3	3	3
3	3	3	4	5	5	5	5	5	5
5	5	5	5	5	5	5	5	6	6
6	6	6	6	6	6	6	7	7	7
8	8	8	8	8	9	9	9	9	9
9	10	10	13	13	13	13	14	14	14
16	16	16	16	16	16	16	16	16	16
16	16	16	17	17	17	18	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20								

Site: ROOT LAKE, MAN. Species: WHITE SPRUCE (PICEA GLAUCA)
Longitude: 101 deg. 22 min. W Latitude: 54 deg. 06 min. N
Date collected: SEPT.16&21,1981 Collectors: L.A. JOZSA, J.M. POWELL, M.B. SCHULTZ
Tree-ring parameter: MAXIMUM RING DENSITY
Chronology type: "C"
YEARS: 1829 1981

TREE RING INDICES

DATE	0	1	2	3	4	5	6	7	8	9
1820										.99
1830	.98	1.07	.96	.99	1.00	1.11	.91	.99	.99	1.00
1840	1.01	1.01	.96	1.01	1.02	1.01	1.03	.93	.98	.99
1850	1.03	1.03	.98	.99	1.00	.99	1.02	1.00	.96	1.03
1860	1.01	1.01	1.02	1.01	.92	1.04	1.02	1.01	.96	1.00
1870	1.01	.97	1.01	1.01	1.06	.96	1.03	.95	1.00	1.02
1880	.93	1.02	1.03	1.00	1.04	1.00	.93	1.01	.99	1.05
1890	.98	1.02	.97	.99	1.01	1.03	1.00	.98	1.02	.93
1900	1.05	1.03	.98	1.00	1.01	1.02	1.00	.94	1.03	.99
1910	1.00	1.03	1.00	1.00	.98	1.01	.99	1.01	.97	1.02
1920	.97	1.01	1.02	1.01	1.00	.97	1.02	1.00	1.01	1.00
1930	.97	.97	1.03	1.03	.99	.98	1.01	1.01	.98	.99
1940	1.04	.99	.94	1.01	1.00	1.00	1.00	1.03	.99	1.00
1950	.97	1.01	1.04	1.00	.97	1.03	.97	1.00	1.00	1.03
1960	1.02	.93	.99	1.03	.98	1.00	1.05	.97	1.04	1.02
1970	.86	1.05	1.03	1.03	1.00	.93	1.06	1.01	.99	1.04
1980	.92	1.03								

NUMBER OF RADII

0	1	2	3	4	5	6	7	8	9
									2
2	2	2	2	2	2	2	3	3	3
3	3	3	4	5	5	5	5	5	5
5	5	5	5	5	5	5	5	6	6
6	6	6	6	6	6	6	7	7	7
8	8	8	8	8	9	9	9	9	9
9	10	10	13	13	13	13	14	14	14
16	16	16	16	16	16	16	16	16	16
16	16	16	17	17	17	18	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20								

Site: ROOT LAKE, MAN. Species: WHITE SPRUCE (PICEA GLAUCA)
Longitude: 101 deg. 22 min. W Latitude: 54 deg. 06 min. N
Date collected: SEPT.16&21,1981 Collectors: L.A. JOZSA, J.M. POWELL, M.B. SCHULTZ
Tree-ring parameter: MAXIMUM RING DENSITY
Chronology type: "B&C"
YEARS: 1829 1981

TREE RING INDICES

DATE	0	1	2	3	4	5	6	7	8	9
1820										.97
1830	.97	1.06	.95	.99	1.00	1.10	.98	.97	.98	.99
1840	1.01	1.02	.98	1.04	1.05	1.04	1.03	.92	.96	.98
1850	1.04	1.05	1.00	1.01	1.02	1.01	1.03	1.01	.97	1.05
1860	1.02	1.02	1.03	1.01	.92	1.04	1.01	1.02	.96	1.00
1870	1.02	.99	1.04	1.04	1.07	.97	1.02	.93	.97	.99
1880	.91	1.02	1.03	1.01	1.05	1.00	.93	1.00	.99	1.05
1890	.97	1.01	.95	.97	1.00	1.03	1.00	.99	1.03	.94
1900	1.07	1.05	1.01	1.02	1.03	1.03	1.01	.95	1.03	1.00
1910	1.01	1.04	1.01	1.00	.98	1.00	.98	1.00	.96	1.00
1920	.96	1.01	1.03	1.01	1.00	.96	1.02	.99	1.00	.98
1930	.96	.97	1.03	1.04	.99	.98	1.01	1.00	.96	.97
1940	1.02	.97	.93	1.00	1.00	1.02	1.02	1.06	1.02	1.04
1950	1.00	1.05	1.00	1.03	.99	1.05	.99	1.02	1.01	1.03
1960	1.02	.92	.97	1.02	.98	1.00	1.06	.98	1.04	1.01
1970	.86	1.06	1.04	1.06	1.02	.95	1.00	1.02	.98	1.03
1980	.98	1.00								

NUMBER OF RADII

0	1	2	3	4	5	6	7	8	9
									2
2	2	2	2	2	2	2	3	3	3
3	3	3	4	5	5	5	5	5	5
5	5	5	5	5	5	5	5	6	6
6	6	6	6	6	6	6	7	7	7
8	8	8	8	8	9	9	9	9	9
9	10	10	13	13	13	13	14	14	14
16	16	16	16	16	16	16	16	16	16
16	16	16	17	17	17	18	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20	20	20	20	20	20	20	20	20
20	20								

Site: SUWANNEE RIVER, MAN. Species: WHITE SPRUCE (PICEA GLAUCA)
Longitude: 99 deg. 54 min. W Latitude: 56 deg. 06 min. N
Date collected: SEPT. 24, 1981 Collectors: L.A. JOZSA, M.B. SCHULTZ
Tree-ring parameter: RING WIDTH
Chronology type: "B"
YEARS: 1855 1981

TREE RING INDICES

DATE	0	1	2	3	4	5	6	7	8	9
1850						.86	.88	.91	.94	.97
1860	.95	.97	.98	.97	.98	.91	.93	.94	.96	1.00
1870	.95	1.00	1.04	1.07	1.02	1.04	.91	.95	.98	1.01
1880	1.03	.96	.95	.92	.98	.98	.92	.97	1.02	1.06
1890	1.08	1.09	1.10	1.11	1.12	1.12	1.11	1.08	1.05	1.03
1900	1.01	.99	.96	.92	.88	.86	.85	.87	.90	.94
1910	1.05	1.06	1.06	1.04	1.01	.98	.98	.98	.98	.98
1920	.98	.97	.95	.92	.89	.86	.85	.84	.84	.85
1930	.87	.91	.98	1.06	1.12	1.17	1.18	1.16	1.12	1.09
1940	1.07	1.06	1.06	1.07	1.10	1.12	1.12	1.11	1.08	1.04
1950	.98	.93	.89	.87	.87	.88	.91	.94	.97	.99
1960	1.01	1.02	1.03	1.05	1.07	1.08	1.07	1.04	1.00	.97
1970	.95	.94	.95	.95	.95	.97	1.00	1.02	1.02	.99
1980	.95	.93								

NUMBER OF RADII

0	1	2	3	4	5	6	7	8	9
					1	1	1	1	1
2	2	2	2	3	3	3	3	3	3
6	7	7	7	8	8	11	11	11	11
11	13	13	13	13	13	13	13	13	13
13	13	13	13	13	13	13	13	13	13
14	14	14	14	14	14	14	14	14	14
16	16	16	16	16	16	16	16	16	16
17	17	17	17	17	17	17	17	17	17
17	17	17	17	18	18	18	18	18	18
18	18	18	18	18	18	18	18	18	18
18	18	18	18	18	18	18	18	18	18
18	18	18	18	18	18	18	18	18	18
18	18	18	18	18	18	18	18	18	18
18	18								

Site: SUWANNEE RIVER, MAN. Species: WHITE SPRUCE (PICEA GLAUCA)
Longitude: 99 deg. 54 min. W Latitude: 56 deg. 06 min. N
Date collected: SEPT. 24, 1981 Collectors: L.A. JOZSA, M.B. SCHULTZ
Tree-ring parameter: RING WIDTH
Chronology type: "C"
YEARS: 1855 1981

TREE RING INDICES

DATE	0	1	2	3	4	5	6	7	8	9
1850						1.00	1.10	.77	1.22	.91
1860	.98	1.01	.98	1.21	.84	1.00	1.07	1.04	.88	1.05
1870	.85	1.11	1.03	1.03	.98	1.01	1.02	.97	.99	1.04
1880	1.04	.99	1.00	1.06	.81	1.00	.95	.95	1.00	1.11
1890	.86	1.05	1.07	.92	.94	1.22	.98	.98	1.05	1.00
1900	.98	1.09	1.02	1.01	.94	.95	.99	.93	1.00	1.05
1910	.85	1.23	.91	1.06	1.05	.83	.99	1.03	1.05	1.04
1920	.98	1.01	1.11	.99	.93	1.03	.98	1.03	.99	1.04
1930	.94	.89	.97	.95	1.00	1.15	.95	1.05	.99	.99
1940	.92	1.02	1.02	.93	.95	1.12	1.01	.99	.97	1.13
1950	1.00	.91	.86	1.09	.98	1.09	.98	.92	1.13	1.04
1960	.89	1.10	.93	1.05	.84	1.20	1.06	.93	1.01	1.02
1970	.84	1.07	1.05	.94	1.03	.87	1.04	1.04	1.14	1.03
1980	.82	1.02								

NUMBER OF RADII

0	1	2	3	4	5	6	7	8	9
					1	1	1	1	1
2	2	2	2	3	3	3	3	3	3
6	7	7	7	8	8	11	11	11	11
11	13	13	13	13	13	13	13	13	13
13	13	13	13	13	13	13	13	13	13
14	14	14	14	14	14	14	14	14	14
16	16	16	16	16	16	16	16	16	16
17	17	17	17	17	17	17	17	17	17
17	17	17	17	18	18	18	18	18	18
18	18	18	18	18	18	18	18	18	18
18	18	18	18	18	18	18	18	18	18
18	18	18	18	18	18	18	18	18	18
18	18	18	18	18	18	18	18	18	18
18	18								

Site SUWANNEE RIVER, MAN. Species: WHITE SPRUCE (PICEA GLAUCA)
Longitude: 99 deg. 54 min. W Latitude: 56 deg. 06 min. N
Date collected: SEPT. 24, 1981 Collectors: L.A. JOZSA, M.B. SCHULTZ
Tree-ring parameter: RING WIDTH
Chronology type: "B&C"
YEARS: 1855 1981

TREE RING INDICES

DATE	0	1	2	3	4	5	6	7	8	9
1850						.86	.97	.78	1.14	.88
1860	.93	.98	.95	1.18	.76	.91	.99	.98	.85	1.04
1870	.88	1.12	1.08	1.10	1.00	1.05	.93	.93	.97	1.06
1880	1.06	.95	1.03	.98	.74	.89	.87	.93	1.10	1.10
1890	.93	1.15	1.10	1.03	1.06	1.37	1.00	1.06	1.11	1.02
1900	.91	1.07	.98	.93	.83	.81	.85	.81	.91	1.00
1910	.90	1.32	.96	1.10	1.06	.81	.97	1.01	1.03	1.03
1920	.88	.98	1.05	.92	.83	.89	.76	.87	.84	.89
1930	.81	.81	.96	1.01	1.22	1.35	1.12	1.22	1.11	1.07
1940	.99	1.08	1.08	.99	1.04	1.25	1.14	1.10	1.06	1.10
1950	.99	.85	.77	.95	.79	.97	.81	.87	1.10	1.03
1960	.90	1.12	.96	1.10	.90	1.30	1.13	.97	1.01	.99
1970	.88	1.02	.99	.88	.99	.85	1.05	1.06	1.15	1.01
1980	.79	.94								

NUMBER OF RADII

0	1	2	3	4	5	6	7	8	9
					1	1	1	1	1
2	2	2	2	3	3	3	3	3	3
6	7	7	7	8	8	11	11	11	11
11	13	13	13	13	13	13	13	13	13
13	13	13	13	13	13	13	13	13	13
14	14	14	14	14	14	14	14	14	14
16	16	16	16	16	16	16	16	16	16
17	17	17	17	17	17	17	17	17	17
17	17	17	17	18	18	18	18	18	18
18	18	18	18	18	18	18	18	18	18
18	18	18	18	18	18	18	18	18	18
18	18	18	18	18	18	18	18	18	18
18	18	18	18	18	18	18	18	18	18
18	18								

Site: SUWANNEE RIVER, MAN. Species: WHITE SPRUCE (PICEA GLAUCA)
Longitude: 99 deg. 54 min. W Latitude: 56 deg. 06 min. N
Date collected: SEPT. 24, 1981 Collectors: L.A. JOZSA, M.B. SCHULTZ
Tree-ring parameter: MAXIMUM RING DENSITY
Chronology type: "B"
YEARS: 1855 1981

TREE RING INDICES

DATE	0	1	2	3	4	5	6	7	8	9
1850						.99	1.01	1.02	1.03	1.04
1860	1.06	1.05	1.04	1.02	1.01	1.00	.99	1.00	1.00	.99
1870	.96	.96	.96	.97	.98	.99	1.02	1.02	1.01	1.00
1880	1.00	1.00	1.01	1.01	1.01	1.01	1.00	1.00	.99	.99
1890	.98	.98	.99	1.00	1.01	1.02	1.02	1.02	1.01	1.01
1900	1.01	1.01	1.01	1.00	1.00	.99	.99	.98	.99	.99
1910	1.00	1.00	1.01	1.01	1.00	1.00	.99	.99	.99	1.00
1920	1.01	1.01	1.00	1.00	.99	1.00	1.00	1.00	1.00	1.00
1930	1.01	1.01	1.00	.99	.98	.99	1.00	1.02	1.03	1.03
1940	1.02	1.01	1.00	.99	.98	.98	.98	.98	.98	.98
1950	.99	1.00	1.02	1.03	1.03	1.02	1.00	.99	.99	1.00
1960	1.01	1.02	1.01	1.01	.99	.99	.99	.99	.99	.99
1970	1.00	1.01	1.02	1.01	1.01	1.00	1.00	.99	.99	1.00
1980	1.01	1.02								

NUMBER OF RADII

0	1	2	3	4	5	6	7	8	9
					1	1	1	1	1
2	2	2	2	3	3	3	3	3	3
6	7	7	7	8	8	11	11	11	11
11	13	13	13	13	13	13	13	13	13
13	13	13	13	13	13	13	13	13	13
14	14	14	14	14	14	14	14	14	14
16	16	16	16	16	16	16	16	16	16
17	17	17	17	17	17	17	17	17	17
17	17	17	17	18	18	18	18	18	18
18	18	18	18	18	18	18	18	18	18
18	18	18	18	18	18	18	18	18	18
18	18	18	18	18	18	18	18	18	18
18	18	18	18	18	18	18	18	18	18
18	18								

Site: SUWANNEE RIVER, MAN. Species: WHITE SPRUCE (PICEA GLAUCA)
Longitude: 99 deg. 54 min. W Latitude: 56 deg. 06 min. N
Date collected: SEPT. 24, 1981 Collectors: L.A. JOZSA, M.D. SCHULTZ
Tree-ring parameter: MAXIMUM RING DENSITY
Chronology type: "C"
YEARS: 1855 1981

TREE RING INDICES

DATE	0	1	2	3	4	5	6	7	8	9
1850						.95	1.05	.98	.98	1.00
1860	.95	1.06	1.00	.99	1.01	1.00	.95	.98	1.05	1.06
1870	1.02	.92	1.05	.97	1.01	1.00	1.02	.96	1.04	1.04
1880	.91	.99	1.04	1.02	1.00	.97	1.00	1.05	.95	1.05
1890	.93	1.02	.98	.97	1.05	1.00	.99	1.00	1.03	.93
1900	1.03	1.03	.97	1.00	.99	1.04	1.01	.93	1.00	1.03
1910	.98	1.03	1.02	.95	.99	1.00	.99	.98	.89	1.00
1920	1.02	1.02	1.00	.97	.96	1.03	1.03	1.00	.95	1.01
1930	1.01	1.00	1.04	1.01	.91	1.02	.97	1.05	1.00	1.01
1940	1.04	.96	1.01	.99	1.02	.95	1.04	.96	1.07	.98
1950	.92	1.00	1.07	1.00	.98	1.06	.96	1.00	.96	.97
1960	1.04	1.02	1.01	1.02	.97	.96	1.04	1.02	.99	.95
1970	1.01	1.02	1.04	1.04	.92	.98	1.07	.99	.95	.99
1980	1.00	1.04								

NUMBER OF RADII

0	1	2	3	4	5	6	7	8	9
					1	1	1	1	1
2	2	2	2	3	3	3	3	3	3
6	7	7	7	8	8	11	11	11	11
11	13	13	13	13	13	13	13	13	13
13	13	13	13	13	13	13	13	13	13
14	14	14	14	14	14	14	14	14	14
16	16	16	16	16	16	16	16	16	16
17	17	17	17	17	17	17	17	17	17
17	17	17	17	18	18	18	18	18	18
18	18	18	18	18	18	18	18	18	18
18	18	18	18	18	18	18	18	18	18
18	18	18	18	18	18	18	18	18	18
18	18	18	18	18	18	18	18	18	18
18	18								

Site: SUWANNEE RIVER, MAN. Species: WHITE SPRUCE (PICEA GLAUCA)
Longitude: 99 deg. 54 min. W Latitude: 56 deg. 06 min. N
Date collected: SEPT. 24, 1981 Collectors: L.A. JOZSA, M.D. SCHULTZ
Tree-ring parameter: MAXIMUM RING DENSITY
Chronology type: "B&C"
YEARS: 1855 1981

TREE RING INDICES

DATE	0	1	2	3	4	5	6	7	8	9
1850						.94	1.06	1.00	1.01	1.12
1860	1.00	1.11	1.04	1.01	1.02	1.00	.94	.98	1.04	1.05
1870	.98	.88	1.01	.94	.99	.99	1.04	.98	1.05	1.04
1880	.91	.99	1.05	1.03	1.00	.98	1.01	1.04	.94	1.03
1890	.92	1.01	.98	.98	1.07	1.02	1.01	1.02	1.04	.94
1900	1.04	1.05	.98	1.00	.98	1.03	1.00	.92	.99	1.02
1910	.98	1.04	1.03	.96	.99	1.00	.98	.97	.88	1.00
1920	1.03	1.03	1.00	.96	.96	1.03	1.03	1.00	.95	1.01
1930	1.02	1.01	1.05	1.01	.89	1.01	.97	1.07	1.03	1.03
1940	1.06	.96	1.01	.97	1.00	.93	1.02	.94	1.05	.96
1950	.91	1.01	1.09	1.03	1.01	1.00	.96	.99	.94	.97
1960	1.05	1.04	1.02	1.03	.96	.95	1.02	1.00	.97	.94
1970	1.01	1.03	1.06	1.06	.92	.98	1.07	.99	.94	.98
1980	1.01	1.07								

NUMBER OF RADII

0	1	2	3	4	5	6	7	8	9
					1	1	1	1	1
2	2	2	2	3	3	3	3	3	3
6	7	7	7	8	8	11	11	11	11
11	13	13	13	13	13	13	13	13	13
13	13	13	13	13	13	13	13	13	13
14	14	14	14	14	14	14	14	14	14
16	16	16	16	16	16	16	16	16	16
17	17	17	17	17	17	17	17	17	17
17	17	17	17	18	18	18	18	18	18
18	18	18	18	18	18	18	18	18	18
18	18	18	18	18	18	18	18	18	18
18	18	18	18	18	18	18	18	18	18
18	18	18	18	18	18	18	18	18	18
18	18								

Site: SUWANNEE RIVER, MAN. Species: BLACK SPRUCE (PICEA MARIANA)
Longitude: 99 deg. 54 min. W Latitude: 56 deg. 06 min. N
Date collected: SEPT. 24, 1981 Collectors: L.A. JOZSA, M.B. SCHULTZ
Tree-ring parameter: RING WIDTH
Chronology type: "B"
YEARS: 1853 1981

TREE RING INDICES

DATE	0	1	2	3	4	5	6	7	8	9
1850				.83	.93	1.01	1.08	1.12	1.12	1.09
1860	.83	.84	.85	.83	.85	.89	.92	.94	.97	1.00
1870	1.05	1.11	1.16	1.19	1.19	1.12	1.09	1.08	1.15	1.14
1880	1.11	1.10	1.07	1.02	1.00	.99	.99	.99	.96	.90
1890	.84	.82	.83	.86	.89	.92	.94	.96	.99	1.02
1900	1.03	1.04	1.05	1.03	1.02	.99	.97	.97	.99	1.02
1910	1.07	1.10	1.11	1.11	1.09	1.07	1.06	1.06	1.06	1.04
1920	1.01	.98	.96	.95	.93	.92	.90	.88	.86	.84
1930	.84	.88	.94	1.02	1.09	1.12	1.10	1.04	.97	.92
1940	.90	.91	.95	1.01	1.07	1.13	1.16	1.15	1.12	1.06
1950	1.00	.96	.95	.94	.92	.91	.89	.91	.96	1.01
1960	1.04	1.04	1.03	1.02	1.02	1.02	1.02	1.03	1.03	1.04
1970	1.04	1.04	1.03	1.02	1.02	1.02	1.02	1.01	.96	.89
198-	.81	73								

NUMBER OF RADII

0	1	2	3	4	5	6	7	8	9
			1	1	1	1	1	1	1
3	3	3	5	5	5	5	5	5	5
5	5	5	6	6	7	8	8	10	10
11	11	11	11	11	11	11	11	11	11
12	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12
12	12								

Site: SUWANNEE RIVER, MAN. Species: BLACK SPRUCE (PICEA MARIANA)
Longitude: 99 deg. 54 min. W Latitude: 56 deg. 06 min. N
Date collected: SEPT. 24, 1981 Collectors: L.A. JOZSA, M.B SCHULTZ
Tree-ring parameter: RING WIDTH
Chronology type: "C"
YEARS: 1853 1981

TREE RING INDICES

DATE	0	1	2	3	4	5	6	7	8	9
1850				.97	1.05	1.01	1.09	.90	1.30	.83
1860	.97	1.08	1.01	.98	.91	1.02	1.08	1.12	.89	1.00
1870	.85	1.12	1.07	.99	.96	1.06	1.06	.90	.98	1.02
1880	.96	1.08	1.08	.99	.78	1.03	1.09	.95	1.15	1.02
1890	.78	.95	1.07	.83	1.05	1.15	.92	.94	.99	1.09
1900	.96	1.01	.96	1.08	1.08	1.02	.91	.96	.93	1.08
1910	.87	1.21	.87	1.11	1.11	.81	.96	1.03	1.12	1.07
1920	.84	.99	1.04	1.00	.93	1.00	.97	1.06	.89	1.05
1930	.91	.86	1.03	.93	1.07	1.23	.95	1.05	.93	.97
1940	.85	.99	1.05	.00	.97	1.19	.94	1.10	.99	1.04
1950	.96	.92	.85	1.18	.97	1.11	.78	.00	.99	1.18
1960	.96	1.11	.00	1.03	.89	1.13	.97	.95	.95	1.14
1970	.00	1.04	1.03	.98	.95	1.01	1.00	1.03	1.13	1.03
1980	.00	1.02								

NUMBER OF RADII

0	1	2	3	4	5	6	7	8	9
			1	1	1	1	1	1	1
3	3	3	5	5	5	5	5	5	5
5	5	5	6	6	7	8	8	10	10
11	11	11	11	11	11	11	11	11	11
12	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12
12	12								

Site: SUWANNEE RIVER, MAN. Species: BLACK SPRUCE (PICEA MARIANA)
Longitude: 99 deg. 54 min. W Latitude: 56 deg. 86 min. N
Date collected: SEPT. 24, 1981 Collectors: L.A. JOZSA, N.D. SCHULTZ
Tree-ring parameter: RING WIDTH
Chronology type: "BAC"
YEARS: 1853 1981

TREE RING INDICES

DATE	0	1	2	3	4	5	6	7	8	9
1850				.81	.90	1.02	1.10	1.00	1.46	.91
1860	.81	.90	.86	.82	.77	.91	.93	1.06	.86	1.00
1870	.89	1.25	1.25	1.10	1.14	1.21	1.15	.90	1.12	1.16
1880	1.06	1.19	1.15	1.02	.70	1.02	1.00	.95	1.12	.93
1890	.67	.79	.89	.71	.94	1.06	.86	.90	.90	1.12
1900	1.00	1.06	1.02	1.12	1.01	1.00	.89	.94	.93	1.10
1910	.93	1.33	.97	1.22	1.21	.00	1.01	1.10	1.10	1.11
1920	.85	.97	1.00	.96	.87	.99	.00	.94	.77	.89
1930	.77	.75	.97	.95	1.10	1.30	1.04	1.09	.90	.90
1940	.76	.90	1.00	.00	1.04	1.35	1.10	1.27	1.10	1.11
1950	.97	.89	.81	1.11	.91	1.01	.69	.81	.95	1.20
1960	1.01	1.16	.91	1.05	.91	1.16	1.01	.97	.90	1.20
1970	.92	1.09	1.07	.99	.97	1.04	1.04	1.05	1.00	.92
1980	.72	.71								

NUMBER OF RADII

0	1	2	3	4	5	6	7	8	9
			1	1	1	1	1	1	1
3	3	3	5	5	5	5	5	5	5
5	5	5	6	6	7	8	8	10	10
11	11	11	11	11	11	11	11	11	11
12	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12
12	12								

Site: SUWANNEE RIVER, MAN. Species: BLACK SPRUCE (PICEA MARIANA)
Longitude: 99 deg. 54 min. W Latitude: 56 deg. 86 min. N
Date collected: SEPT. 24, 1981 Collectors: L.A. JOZSA, N.D. SCHULTZ
Tree-ring parameter: MAXIMUM RING DENSITY
Chronology type: "B"
YEARS: 1853 1981

TREE RING INDICES

DATE	0	1	2	3	4	5	6	7	8	9
1850				.96	.98	1.01	1.04	1.06	1.06	1.05
1860	1.01	1.00	.99	.98	.98	.99	1.00	1.01	1.02	1.01
1870	.99	.98	.98	.99	.99	1.00	1.00	1.00	.99	1.00
1880	1.00	1.01	1.02	1.02	1.02	1.01	.99	.99	.98	.98
1890	.98	.98	.99	.99	1.00	1.00	.99	.98	.98	.99
1900	.99	1.00	1.00	1.00	1.00	1.00	1.00	1.01	1.01	1.01
1910	1.02	1.01	1.01	1.01	1.01	1.00	1.00	.99	.99	1.00
1920	1.01	1.01	1.00	1.00	1.00	1.00	1.00	.99	.99	.98
1930	.98	.99	.99	.99	.99	.99	1.00	1.00	1.01	1.01
1940	1.02	1.01	1.01	1.00	1.00	1.01	1.01	1.01	1.01	1.01
1950	1.01	1.01	1.01	1.01	1.00	.99	.99	.99	.99	1.00
1960	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	.99
1970	.99	.99	.99	.99	.99	1.00	1.01	1.02	1.02	1.01
1980	1.01	1.01								

NUMBER OF RADII

0	1	2	3	4	5	6	7	8	9
			1	1	1	1	1	1	1
3	3	3	5	5	5	5	5	5	5
5	5	5	6	6	7	8	8	10	10
11	11	11	11	11	11	11	11	11	11
12	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12
12	12								

Site: SUWANNEE RIVER, MAN. Species: BLACK SPRUCE (PICEA MARIANA)
Longitude: 99 deg. 54 min. W Latitude: 56 deg. 06 min. N
Date collected: SEPT. 24, 1981 Collectors: L.A. JOZSA, N.B. SCHULTZ
Tree-ring parameter: MAXIMUM RING DENSITY
Chronology type: "C"
YEARS: 1853 1981

TREE RING INDICES

DATE	0	1	2	3	4	5	6	7	8	9
1850				1.09	.98	.97	1.05	1.07	1.00	.99
1860	.99	1.02	.99	.99	.99	1.00	.96	1.04	1.02	1.00
1870	.97	.92	1.03	.98	1.01	1.02	1.02	.95	1.03	1.01
1880	.94	1.01	1.04	1.02	1.00	1.00	.98	1.02	.96	1.03
1890	.99	1.02	.96	.97	1.07	1.02	.98	.97	1.02	.96
1900	1.03	1.02	.98	1.01	.99	1.01	.98	.98	1.02	1.03
1910	.95	1.04	1.00	.96	1.01	1.00	.96	.96	.97	1.04
1920	1.01	1.01	1.00	1.02	.91	1.07	1.02	1.01	.94	1.02
1930	.99	1.00	1.04	.97	.99	1.04	.95	1.04	.96	1.01
1940	1.05	.97	1.02	.96	1.01	.97	1.05	.99	1.01	.98
1950	.98	1.00	1.06	.98	.98	1.03	.97	1.00	1.01	.97
1960	1.01	1.02	1.01	.99	.95	1.05	.99	1.02	1.02	.99
1970	.94	1.05	1.00	1.01	.95	.99	1.02	1.04	1.00	.97
1980	1.02	1.00								

NUMBER OF RADII

0	1	2	3	4	5	6	7	8	9
			1	1	1	1	1	1	1
3	3	3	5	5	5	5	5	5	5
5	5	5	6	6	7	8	8	10	10
11	11	11	11	11	11	11	11	11	11
12	12	12	12	12	12	12	12	12	12

CHURCHILL RIVER BLACK SPRUCE RING WIDTH "C" CHRONOLOGY
YEARS: 1870 1981

TREE RING INDICES

DATE	0	1	2	3	4	5	6	7	8	9
1870	1.03	1.00	.91	.96	1.10	1.10	.84	1.02	1.30	.73
1880	.52	.63	1.01	1.23	1.09	1.00	1.05	1.11	1.01	.96
1890	.96	1.06	.89	1.06	.96	.99	.96	1.01	.92	.92
1900	1.16	.87	1.07	.96	.93	1.02	1.02	1.07	.97	1.02
1910	.97	.98	.96	1.05	1.08	.92	1.02	1.04	1.00	.95
1920	.89	1.14	1.03	.91	.98	1.07	1.02	.95	.98	1.11
1930	.92	.98	1.00	.94	1.10	1.21	.89	.82	.93	1.00
1940	1.02	.93	.97	1.05	.92	.95	1.19	1.01	1.05	.94
1950	.87	1.12	.88	1.14	1.06	1.13	.68	1.11	.81	1.14
1960	1.01	1.04	.96	1.11	.74	1.04	1.19	.99	.89	1.12
1970	.93	.93	1.11	.92	.98	.99	.95	.97	1.11	1.08
1980	.68	1.19								

NUMBER OF RADII

0	1	2	3	4	5	6	7	8	9
1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1
1	3	3	7	9	11	12	12	12	12
14	15	17	17	17	17	17	17	19	19
20	20	20	20	20	22	22	22	22	22
22	22	22	22	22	22	22	22	22	22
22	22	22	22	22	22	22	22	22	22
22	22	22	22	22	22	22	22	22	22
22	21	21	21	21	21	21	21	21	21
21	21	21	21	21	21	21	20	20	20
20	20	20	20	20	20	20	20	20	20
20	19								

CHURCHILL RIVER BLACK SPRUCE MAXIMUM DENSITY "C" CHRONOLOGY
YEARS: 1870 1981

TREE RING INDICES

DATE	0	1	2	3	4	5	6	7	8	9
1870	1.02	.98	1.00	1.02	.99	1.01	1.00	.97	1.01	1.05
1880	.92	1.04	1.07	1.01	.95	.95	1.01	1.02	.94	1.13
1890	.98	.93	1.01	1.00	1.00	1.00	1.01	1.02	.99	.93
1900	1.04	1.02	.98	1.01	1.03	.93	1.02	1.00	.97	1.02
1910	1.01	.99	1.00	.99	1.00	1.06	1.00	.96	.95	1.04
1920	1.00	1.01	1.06	.92	.97	1.04	1.02	1.02	.95	1.00
1930	1.01	1.01	1.02	.99	.95	1.07	.96	1.05	.99	.96
1940	1.02	1.02	.99	.98	1.01	.92	1.07	.99	1.05	.95
1950	.98	1.02	1.06	.96	1.01	1.07	.91	1.05	.93	.98
1960	1.04	.99	1.00	1.05	.95	1.02	1.00	.97	.91	1.00
1970	1.02	1.03	.97	1.07	.91	1.04	.98	1.04	.91	.95
1980	.97	1.12								

NUMBER OF RADII

0	1	2	3	4	5	6	7	8	9
1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1
1	3	3	7	9	11	12	12	12	12
14	15	17	17	17	17	17	17	19	19
20	20	20	20	20	22	22	22	22	22
22	22	22	22	22	22	22	22	22	22
22	22	22	22	22	22	22	22	22	22
22	22	22	22	22	22	22	22	22	22
22	21	21	21	21	21	21	21	21	21
21	21	21	21	21	21	21	20	20	20
20	20	20	20	20	20	20	20	20	20
20	19								

POOR

QUALITY

ORIGINAL